ROYAL ASTRONOMICAL SOCIETY.

VOL. XI. *February* 15, 1851. No. 4.

THE Annual General Meeting of the Society, G. B. AIRY, Esq., Astronomer Royal, President, in the chair.

The Rev. F. W. Russell, South Shields;
John Peto, Esq., Southampton;
E. J. Collingwood, Esq., Lilburn Tower, near Belford;
Charles Greville Prideaux, Esq., Lincoln's Inn; and
Rev. James Hill, Greenwich;
were balloted for and duly elected Fellows of the Society.

Report of the Council to the Thirty-first Annual General Meeting.

The pleasure with which the Council meet their constituents is often expressed in terms of unmixed congratulation on the prospects of Astronomy, as inferred from its history during the year elapsed. On the present occasion, it must be confessed that the recent loss of Professor Schumacher is a deduction of serious magnitude from the working power of our science. Trusting to what is yet left of that most useful astronomer, his memory and his example, the Council hope that the loss may be repaired by the joint efforts of those whose local position will enable them to aim at filling his peculiar place.

The Report of the Auditors, subjoined, will show the state of the finances:—

RECEIPTS.

	£	s.	d.
Balance of last year's account	480	14	5
1 year's dividend on £900 Consols	26	4	4
1 ditto on £2363 12*s.* 6*d.* 3¼ per Cents	74	11	8
On account of arrears of contributions	85	17	0
78 contributions (1850–51)	163	16	0
2 ditto (1851–52)	4	4	0
4 compositions	84	0	0
19 admission fees	39	18	0
16 first year's contributions	26	5	0
Sale of Memoirs, &c.	75	15	9
	£1061	6	2

EXPENDITURE.

	£	s.	d.
J. Rumfitt, bookbinder	7	3	10
J. Basire, engraver	7	4	10
G. Barclay, for printing Memoirs	127	3	1
Ditto ditto Monthly Notices, &c.	98	11	0
Cash paid for investment of £250, 3 per Cent Consols	241	17	6
Mr. J. W. Woollgar, for Library Catalogue	24	12	6
Taxes { Land tax and window duty, 1 year ... 8 3 1			
Taxes { Income and property tax, 1 year ... 1 9 2			
	9	12	3
J. Williams, 1 year's salary as Assistant-secretary	100	0	0
Ditto commission on collecting £395 15*s.* 9*d.*	19	15	9
Charges on books, and carriage of parcels	3	13	3
Postage of letters and Monthly Notices	26	19	7
Porter's and charwoman's work	13	18	6
Tea, sugar, biscuits, &c. for evening meetings	13	13	0
Coals, candles, &c.	12	18	6
Sundry disbursements by the Treasurer	23	14	8
Balance in the hands of the Treasurer (Jan. 1851)	330	7	11
	£1061	6	2

Assets and present property of the Society:—

	£	s.	d.
Balance in the hands of the Treasurer	330	7	11
1 contribution of 6 years' standing ... £12 12 0			
1 ——— of 5 ditto ... 10 10 0			
7 ——— of 3 ditto ... 44 2 0			
11 ——— of 2 ditto ... 46 4 0			
25 ——— of 1 ditto ... 52 10 0			
	165	18	0
Due for publications of the Society	2	12	0

£1150 3 per Cent Consols.
£2363 12*s.* 6*d.* New 3½ per Cent Annuities.
Unsold publications of the Society.
Various astronomical instruments, books, prints, &c.

Stock of volumes of the *Memoirs*:—

Vol.	Total.	Vol.	Total.	Vol.	Total.
I. Part 1	45	V.	186	XIII.	277
I. Part 2	90	VI.	204	XIV.	464
II. Part 1	107	VII.	229	XV.	251
II. Part 2	73	VIII.	216	XVI.	277
III. Part 1	135	IX.	222	XVII.	271
III. Part 2	155	X.	236	XVIII.	297
IV. Part 1	158	XI.	247		
IV. Part 2	172	XII.	259		

Progress and present state of the Society:—

	Compounders.	Annual Contributors.	Non-residents.	Patroness, and Honorary.	Total Fellows.	Associates.	Grand Total.
February 1850	122	157	70	6	355	57	412
Since elected	3	15	...	...	18	5	23
Deceased	−3	−3	−4	...	−10	−2	−12
Removals	3	−3	...	...	...	...	...
Resigned	...	−2	...	...	− 2	...	− 2
Expelled	...	−3	...	...	− 3	...	− 3
February 1851	125	161	66	6	358	60	418

The instruments belonging to the Society are now distributed as follows :—

The *Harrison* clock,
The *Owen* portable circle,
The *Owen* portable quadruple sextant,
The *Beaufoy* circle,
The *Beaufoy* transit,
The *Herschelian* 7-foot reflector,
The *Greig* universal instrument,
The *Smeaton* equatoreal,
The *Cavendish* apparatus,
The Universal quadrant by Abraham Sharp,
The 7-foot Gregorian reflecting telescope (late Mr. Shearman's),
The Variation transit (late Mr. Shearman's),
are in the apartments of the Society.

The Brass quadrant, said to have been *Lacaille's*,
is in the apartments of the Royal Society.

The Standard scale
is in the charge of the Astronomer Royal, with the consent of the Council, to be employed in the formation of a new Standard Measure, under the direction of the Standard Committee.

The remaining instruments are lent, during the pleasure of the Council, to the several parties undermentioned, viz. :

The *Fuller* theodolite, to the Lords of the Admiralty.
The *Beaufoy* clock,
The two invariable pendulums, } to the Royal Society.
The *Wollaston* telescope, to Professor Schumacher.
The other *Beaufoy* clock, to Mr. J. Drew.
The *Lee* circle, to Captain Blackwood.

The 4to. half-volume, containing the longer or more abstruse papers communicated to the Society, is now nearly printed. The articles are not numerous. The longest is one containing the observations made by the late Mr. Fearon Fallows at the Cape of Good Hope, *after* the erection of the Observatory and of the standard instruments. These observations have been fully reduced and printed under the personal care of the Astronomer Royal, at the expense of the Lords of the Admiralty. Your Council have already called your attention to the untiring and patriotic zeal of Mr. Airy, and to the prudent generosity of the Government. The friends of Mr. Fallows (and he had many friends) will rejoice at this contribution to his reputation, and the astronomical world will thankfully receive such an addition to that stock of *certain* facts on which the science rests. The Astronomer Royal may feel a just pride in the services rendered by him to his more immediate predecessors, Bradley, Maskelyne, and Pond; and to these must be added Groombridge and Fallows. Is it too much to hope that the Cape observations of the late Professor Henderson may meet the same or a similar editor? The Annals of the Cape Observatory would then be wholly published and perfectly available.

Professor Challis has contributed a valuable paper on the mode of ascertaining the errors of the pivots of transit instruments. However delicate the workman's tests may be, and however perfect the workmanship applied to the construction of astronomical instruments, the time is gone by when an astronomer of reputation can trust to an unexamined instrument. The most important verification, perhaps, regards the pivots of the transit instrument; and it is this problem which the Professor has solved, simplified, and exemplified.

Mr. Dawes has followed up a former contribution, "On the measures of Double Stars taken at Ormskirk," by a second and final memoir. We have thus a complete account of the labours of this exquisite observer in this most exquisite branch of practical astronomy, while he resided at Ormskirk. Though the instrumental means then in his possession are now far surpassed by those belonging to many observers, and particularly by those which he at present enjoys, the Ormskirk observations are exceedingly valuable from their date and their author. Let us hope that Mr. Dawes may speedily present us with the still more refined results which he has arrived at, while residing at Camden Lodge and Wateringbury.

To Mr. Main we are indebted for a very valuable and laborious paper on the proper motion of the stars contained in the Greenwich 12-year Catalogue. By the help of this memoir, the places of that admirable catalogue may be carried backwards or forwards correctly for several years, while the remarkable stars, which from their proper motion require particular attention, are pointed out as objects to be determined, and so separated from fundamental points. It is, perhaps, to be regretted that separate copies of this memoir were not struck off to accompany the 12-year Catalogue; but, for

the most part, the possessors of the one publication will naturally possess the other.

The arbitrary and inaccurate modes which many observers have employed in calculating the longitude from transits of the moon and moon-culminating stars, have struck every one who has had occasion to examine the subject. The Astronomer Royal has undertaken the simple and accurate solution of those cases which are likely to occur; and it is to be hoped that future computers will follow his guidance. The method itself is capable of giving the longitude of distant places with more ease and certainty, perhaps, than any other; and it is to observations of the moon and neighbouring stars that we must mainly look for the gradual improvement of terrestrial geography, by establishing distant normal points.

Professor Chevallier has contributed a short paper on transferring the constants given in the *Nautical Almanac*, relative to the occultations of stars by the moon, to other meridians. By the use of a special table, easily computed for each observatory, the calculation is rendered short and simple, and sufficiently accurate for its purpose. If occultations have lost some of their interest since the improvement of chronometers and the discovery of the electric telegraph, they still supply *one* of the best methods of determining the longitudes of distant places, and, perhaps, the most accurate places of the moon. Of late years their observation has been too much neglected.

Of the *Monthly Notices*, little more need be said than has already appeared in former Reports, and even this may seem unnecessary, as the *Notices* themselves are forwarded to every Member of the Society who wishes to have them, free of expense. They appear to answer the object proposed, viz. to give earlier and wider circulation to the discoveries of the day, to aid the observer with the necessary means for following out and reducing his observations, and to give a full and sufficient account of all memoirs presented to the Society. There is still some want of unity of design; an ephemeris of one planet is at times missing, when duplicates of another may be had. As the Society has no funds to be applied to computation, we are thus dependent on the zeal and goodwill of our friends at home and abroad. There is a little scruple felt in "conveying" ephemerides already printed into our pages, though this is at times overlooked. The general rule is, to abstain from all such ephemerides as are published in works especially designed for them, as the *Nautical Almanac*, the *Jahr-Buch*, &c., and to use the *Comptes Rendus*, and even at times the *Astronomische Nachrichten*, with more freedom. It would be, however, a violation of propriety to borrow largely from the *Nachrichten*, as that work *ought* to be in the possession of every astronomer. There is no way in which a competent computer can make himself more useful than in furnishing early ephemerides of newly-discovered celestial bodies, which are not as yet suffi-

ciently well known to obtain a place in the standard almanacs of France, Prussia, or England. Our acknowledgments are due to M. Leverrier, to M. Yvon Villarceau, to Mr. George Rümker, to Mr. Richard Schumacher, to Mr. Graham, &c., for their assistance in this department.

Notwithstanding the great advances made here and abroad to facilitate scientific communication, there are still difficulties in the way of transmitting to the Continent the *Monthly Notices by post*, or at least we are ignorant of the proper mode of doing it. In France and in other parts of the Continent, such articles can be sent *sous bande* at a very moderate charge; but, so far as we understand the foreign regulations, it is only *the produce of the country* which is thus allowed to circulate. With the seaboard of most civilised countries we can communicate at a very light cost, and in some cases with the interior. But we have no knowledge how to send a *Monthly Notice* to Italy or Switzerland without its costing far more than it is worth; and even in the interior of France, and perhaps in Germany, there seems to be a special and not very moderate postage from the coast. Probably some one familiar with the subject may be able to inform us of the proper way of sending *cheaply* and *rapidly* to the principal towns in Continental Europe; or, if that be not yet practicable, could put us, and others in our situation, into the way of applying to the proper authorities. We feel sure that attention will be paid to any reasonable proposition by our own post-office, and there is no ground to anticipate any objection elsewhere.

In putting together the *Monthly Notices*, some unnecessary trouble is given by slight variations from the customary form. It is desirable that these alterations should be as rare as possible. The MSS. should only be written on one side, and in columns not wider than the printed page will hold. In ephemerides, the places should be *apparent*, as in the standard almanacs; if the computer has not time for the reduction, the circumstance should be clearly pointed out. In this country the practical observer may be an indifferent computer, and almost always dislikes computation: in a variety of methods error is liable to creep in. So, in the observations, the precise extent of reduction should be stated (it almost always is), and everything arranged as is meant for the press. It is admitted that most of the observations come in a most workmanlike form, and that the trouble is in itself really not great. Some advantage would arise if the contributors of matter, which may require immediate attention, would carefully date the paper inside, and write "For the *Monthly Notices*" on the direction. As the Editor is not resident in London, this notice would hasten the delivery in cases where time is important.

The Council intend to take into serious consideration the propriety of making increased efforts for, and devoting additional expenditure to, the circulation of the *Monthly Notices* among the astronomers of the continents of Europe and America. The very great value of this rapid mode of communication will, they think,

justify an outlay of the sort, and the augmented means of the Society will permit it. The *Monthly Notices* are ardently wished for by many astronomers who find great difficulty in obtaining them. The proportion which the cost of distribution bears to that of print and paper is at present not one in five; and it is clear that if there must be a point at which, were it necessary, it would be worth while to print even less, that the result might circulate more, it follows that a Society whose means will afford it, exercises a wrong economy if it do not take care to obtain the maximum of very useful distribution before it begins to consider the future. And in adverting to this subject, the Council will remind the Fellows that the request formerly made for information as to ready means of reaching particular places will be better worth their attention than ever, if the Council shall find it desirable to make increased efforts of the kind described.

The Council have the pleasure of announcing that the catalogue of the library is now completed and published. The warmest thanks of the Society are due to Mr. Woolgar, under whose sole superintendence it was arranged and printed. These thanks are richly due, both for the admirable manner in which the details are presented, and for the economy with which they have been printed. The Fellows will now, for the first time, be able fully to judge of the value of the accession made to the library in the books of the Mathematical Society.

The Council have awarded the gold medal to Signor A. de Gasparis for his discovery of three new asteroids. The President will, at the close of the meeting, present the grounds of this award.

The Society has to regret the loss, by death, of our Associates MM. Schumacher and Trechsel, and of the following Fellows of the Society: — J. Caldecott, Esq.; J. Curnin, Esq.; Rev. T. W. Hornbuckle; Commander Wolfe; Sir Lancelot Shadwell; Capt. Stanley; Wm. Galbraith, Esq.; J. Lane, Esq.; James Pettit; Dr. Lane.

Heinrich Christian Schumacher, Conferenzrath, Professor, Knight Grand Cross of the Order of Dannebrog and Dannebrog's man; Knight of the Royal Prussian Order of the Red Eagle, 2d Class; of the Imperial Russian Order of St. Anne, with brilliants, 2d Class; of the Order of Stanislaus, 2d Class; of the Royal Swedish Order of the North Star; of the Legion of Honour, and Officer of the Order of Leopold in Belgium.

Fellow of the Royal Societies of Copenhagen, London, Edinburgh, Stockholm, Göttingen, Upsala, and Munich; of the Royal Astronomical Society of London; of the American Philosophical Societies of Philadelphia and Boston; of the Physiographical Society of Lund; of the Physical Society of Dantzic; of the Astronomical Society of Leipsic; of the Physical Society of Königsberg, and of the Imperial Society of Moskow.

Honorary Member of the Royal Irish Academy; of the Society

of Useful Arts of Edinburgh; of the Mathematical Society of Hamburg, and of the Physical Society of Rostock.

Correspondent of the Academy of Sciences of Paris; of the Imperial Academy of Sciences of St. Petersburg; of the Royal Academies of Sciences of Berlin; Brussels; Naples; Padua; Palermo; and Turin.

He was born at Bramstedt in Holstein, Sept. 3, 1780. His family, among whom is numbered the celebrated Count Griffenfeldt,* migrated to Holstein from Westphalia in the 16th century. His father, Andreas Schumacher, was first employed in the embassy at St. Petersburg, became afterwards private secretary to Christian VII., and was subsequently appointed *Amtmann*† of Bramstedt, and finally of Segeberg. Andreas Schumacher married Sophia Hedewig, born Weddy, daughter of a clergyman in Oldenburg, and widow of Hofrath Büsching, brother to the well-known geographer. Two children sprang from this marriage,—Heinrich, the eldest, and the subject of this memoir, and Andreas Anton Friederich, who was a distinguished officer in the Danish service, and died when adjutant to Friederich VI.

In 1790, Andreas Schumacher died, recommending his widow and young children to the care of the crown prince, afterwards Friederich VI., by whom he was greatly esteemed. The reigning sovereign bestowed a pension on his widow, who shortly after removed to Altona for the education of her children.

Before coming to Altona, the young Schumachers were instructed by Pastor Dörfer, himself well known as the topographer of Holstein and Schleswig. At Altona they attended the Gymnasium, which was worthily presided over by Jacob Struve, father of our celebrated associate, F. G. W. Struve. Under the care of this excellent teacher, Schumacher became a sound classical scholar; and as the mathematical master was not competent, he also studied mathematics under Jacob Struve's direction, who, himself a polyhistor in the best sense, privately instructed the most promising pupils in this department.

Very early Heinrich Schumacher had shown a taste for mathematics and mechanics: he was fond of making wooden clocks and instruments. But his frame was delicate, and it was at one time deemed advisable to remove him from all causes of excitement. He was accordingly placed in the house of a country clergyman; but having heard that his mother had bought for him a copy of Wolf's *Mathematics*, his impatience to return home and to resume his favourite pursuits was so strong, that his mother thought it best to allow him to return to Altona.

* Griffenfeldt was still considered to be the model of a Danish statesman a hundred years after his disgrace and death. "If I could get back Griffenfeldt alive," said Frederic VI. to the subject of this memoir, "I would dig him up with my nails."

† *Amtmann* is the principal magistrate of his district; its civil and political head. The districts in Holstein may contain about 15,000 or 20,000 souls. We seem to have no analogous single office.

After completing his studies at the Gymnasium, which he left with the reputation of its best scholar, Schumacher went to Kiel, in 1799, purposing to follow the law as a profession. He resided at Göttingen in 1801, and returned to Kiel for the next three years. Though he had little opportunity at Kiel to improve his knowledge of mathematics, he applied himself with great diligence to law, classics, and probably to modern languages. He used to say with some complacency, that if Horace, his favourite author, were lost, he could *restore* him; and the language of his Latin dissertations is said to be remarkable for its clearness and correctness. At whatever time he might acquire his modern languages, it is certain he possessed them with great mastery: he spoke and wrote Danish, French, and English,* with rare perfection, was well versed in Italian, and had made some progress in Russian.

In 1802, the Russian Emperor Alexander founded the University of Dorpat, and in 1804 the Gymnasium of that town was opened. Dr. Charles Struve, eldest son of Jacob Struve, was named the professor of Greek, and he recommended his schoolfellow Schumacher to supply his situation as tutor in the noble Livonian family of Von Meiners. Schumacher began to live with the family in the autumn of 1804, and as they resided alternately at Dorpat and their country-seat at Fölk, about 50 miles from Dorpat, he joyfully seized the opportunity, which his partial residence at Dorpat afforded, to resume his mathematics. In 1805 he began his translation of Carnot's *Géométrie de Position* into German, *ad recreationem animi*, as he says himself, in the introduction to the work. This translation, with notes by Gauss, was published at Hamburg in two volumes.

J. W. Pfaff was professor of astronomy and mathematics at Dorpat, and under his enthusiastic guidance Schumacher commenced his career as an astronomical observer and calculator. In a publication by Pfaff, which only extended to three numbers, the *Dorpater Astronomische Beyträge*, Schumacher contributed the places of the sun from Zach's Tables to Number II. In Number III. he explained an obscure passage in Hyginus, and also determined the latitude of Dorpat from sextant observations made between March 27 and April 8, 1807.

In 1806 he took his degree as *Doctor utriusque Juris* at Göttingen, in honour it would seem of his treatise, *Dispunctionum juridicarum specimen*, published at Dorpat in 1805. He chose for his doctor's thesis, "*De publicis servis populi Romani.*" This dissertation was published, and dedicated to his old friend and tutor, Pastor Dörfer.

But at Dorpat the young jurist's heart had been won for astronomy. His first intention was to go to Paris and place himself under Lalande. The death of Lalande, which happened in April 1807, deranged this plan, to which Lalande had given his consent.

* The Professor's skill in English may be judged of from this,—he could *enjoy* the writings of Dickens when read aloud to him.

In 1807 Schumacher returned to Altona. Through the patronage of Count Reventlow, *curator** of the University of Kiel, he obtained, in 1809, from the Danish Government a small allowance to enable him to perfect his scientific studies at Göttingen, under the direction of the illustrious Gauss. Here he made the personal acquaintance of that excellent astronomer, Olbers, and the friendships thus commenced continued till death.

In 1810, Schumacher was appointed extraordinary Professor of Astronomy at Copenhagen. He applied for permission to postpone his residence for a year, that he might complete an astronomical work which he had commenced in the private observatory of Repsold, his very intimate friend. This was granted, but the work has not yet appeared.

As Bugge was still professor of astronomy, and occupied the observatory of Copenhagen, Schumacher was advised by his sincere friend and patron, the late Duke of Augustenburg, to take charge of the observatory of Mannheim, then vacant by the death of the Abbé Barry. The permission of the King of Denmark to accept this office was granted, on the express condition that he should return to Copenhagen on Bugge's death. Previous to his entering upon his duties at Mannheim, Schumacher married Christine Magdalene von Schoon. He resided at the observatory of Mannheim till Bugge's death in 1815, when he was recalled to Copenhagen. Except his Latin tract on the latitude of Mannheim, it does not appear that there is any published account of his observations.

Before returning to Copenhagen, Professor Schumacher waited on Friederich VI. at Vienna. Notwithstanding the painful position of the Danish monarch at that eventful time, he made himself acquainted with the nature of Schumacher's duties, and ever afterwards showed himself a steady and liberal patron of astronomy and of its professor.

In the autumn of 1815, Professor Schumacher delivered a course of lectures on astronomy, *in Latin*, before the University of Copenhagen, and occupied the Observatory. In 1816 he prepared to carry into execution the trigonometrical survey of the kingdom of Denmark, which was also to include an arc of the meridian from Lauenburg to Skagen, the northern point of Jutland. As the survey commenced with Holstein, it was convenient that the director should live near the scene of his operations.

In or before 1820, Schumacher took up his residence at Altona, in a house bought for him by the king. Friederich VI. and Christian VIII. were both attached to science, and both most liberal patrons of astronomy and geodesy. The observatory of Altona was founded in 1823, and the first observation with the meridian circle of Reichenbach was made September 18, 1823. This observatory has become the point of union between Greenwich and the observatories of Germany and Russia, and has obtained a spe-

* *Curator* is the name of an officer which does not exist in our universities. He seems to be the patron and official protector, like our Chancellors, but with more action on the university corporation and studies.

cial reputation for the discovery of comets by Dr. Petersen. During the reigns of the above-mentioned monarchs, a museum was formed of the best astronomical and geodesical instruments from all countries. It is to this collection that England is indebted for the authentic copy of the *Imperial pound*, which has been adopted by Professor Miller in restoring the parliamentary standards destroyed by the fire of 1834.

In 1816 the Professor received at Munich, from Reichenbach, a theodolite, the first instrument required for the survey. In 1819 he visited France and England in reference to the survey. In the same year he determined the latitude of Lauenburg, the southern point of the proposed arc, with Ramsden's zenith sector, which the English Government had lent for the operation. On this occasion he was visited by his old friend Olbers, and by Bessel, probably for the first time. The intimate friendship between Bessel and Schumacher dates from this period, and continued through life. Whenever Bessel made a journey into Germany, he contrived to pay a visit to Altona.

Professor Schumacher, in his astronomical and geodesical pursuits, had the advantage of being most intimately acquainted with the celebrated artist, Repsold of Hamburg. Repsold constructed the excellent base apparatus, which Schumacher has described in his letter to Olbers, published in 1821. The measure of the base at Braak begun in 1820. Besides Repsold and his own assistants, of whom Professor Hansen was one, Schumacher was aided by Gauss, Bessel, Struve, and other astronomers.

Every year Professor Schumacher visited Copenhagen, to arrange the affairs of the survey and the observatory, and to present himself to the king. We are told that his reception by Friederich VI. and Christian VIII. was always of the most flattering nature. The Professor, by the desire of the latter monarch, wrote regularly to him, on the current events of astronomy and general science. During Olbers' life he made a yearly visit to Bremen.

In 1826 Professor Schumacher visited Munich a second time, to inspect the establishment of Utzschneider and Fraunhofer, and that of Reichenbach and Ertel, probably with reference to instruments for the survey.

In 1840 the Professor visited the magnificent observatory of Pulkova, which had been recently erected under the direction of Struve: and in 1842 he went to Vienna, to observe the total solar eclipse. This seems to have been his last scientific journey of importance.

Professor Schumacher's family consisted of three daughters and two surviving sons, of whom the youngest, Richard, has attached himself to astronomy. He is already favourably known as an observer and calculator to the readers of the *Astronomische Nachrichten*, and this Society has been obliged to him in the course of the past year for the elements and a careful ephemeris of Petersen's third comet, with an elaborate comparison of his ephemeris and the observations of different observers. Richard Schumacher is now

residing at Königsberg, to complete his studies under the able direction of Dr. Peters.

Among the Professor's numerous publications, it is sufficient here to take particular notice of the following.

A collection of Astronomical Tables, in two parts; the first part contains many of the tables most commonly required in the observatory; and the second part consists of the subsidiary tables by which the reduction of Lalande's *Histoire Céleste* has been performed. This part was dedicated to the Astronomical Society, towards which the Professor always felt great regard.

Ephemerides of the bright planets from 1820 to 1829, and of the distances of the bright planets from the moon for ten years, from 1822 to 1831 inclusive. The latter was published in English, and adapted to Greenwich mean time. In the remodelling of the *Nautical Almanac*, the introduction of the lunar distances of the planets was certainly the most important *nautical* improvement.

His astronomical *Jahrbuch*, from 1836 to 1844. This elegant publication, besides a variety of useful tables, contains numerous popular scientific views and summaries by the greatest geometers of the continent.

Lastly, Schumacher's greatest work, and that by which he will always be remembered as the most *useful* astronomer of his time, the *Astronomische Nachrichten*, which he commenced in 1821, and carried on till the time of his death. To this great work Schumacher brought extraordinary qualifications; unwearied industry, high scientific acquirements, the most favourable local position, rare knowledge of modern languages, and, what was still more important, a kind temper, united with enthusiastic zeal. His habits of business were exact, and his punctuality in correspondence unfailing. To this he added courteous and refined manners, principally, no doubt, owing to natural temper, but carefully cultivated by a large experience of mankind. He was thus enabled to unite astronomers of all countries and all shades of opinion in their common pursuit, and it is not too much to say that he principally has impressed upon astronomy its present cosmopolitan character.

In 1829 this Society awarded him their gold medal for the *Nachrichten*, and the President, Sir John Herschel, addressed him in the following words, which do by no means go beyond the limits of strict truth :—

"Among those numerous and talented individuals throughout the Continent, and in England, who are attached to astronomy professionally, or from love to the science, the *Astronomische Nachrichten* of Professor Schumacher establishes a point of concourse—a complete bond of union. We have there a theatre of discussion of whatever is most new and refined in the theory and practice of astronomy, the utmost delicacies of computation and scrupulous investigation of instrumental errors are given by those most competent to supply and to judge of them. To its pages observations of every kind find their way, especially those which depend for their utility on corresponding observations, or which lose their in-

terest and importance by long suppression. Not a comet appears but *there* we find its elements, handed in from all quarters with emulous rapidity. Occultations, moon-culminating observations, computations of longitudes and latitudes, disquisitions on practical points, descriptions, advertisements, and prices of instruments,—in a word, everything which can awaken and keep alive attention to the science, everything that can facilitate the contact of mind with mind. Every one who has attended to the progress of knowledge in recent times must feel all the importance of such an engine. But it cannot be kept in action without a strong presiding power. In any inferior hand it would languish and soon fall into disrepute and inaction. Professor Schumacher is, of all men, that one whom the voice of Europe would have fixed on for the conduct of such a work,—an excellent astronomer himself, and presiding over an observatory in which everything is delicate and exquisite, he possesses that practical and theoretical knowledge which commands respect and gives his acceptance or rejection of contributions a weight from which there is no appeal. He has, moreover, the eminent but merited good fortune to possess the full and effective support of a government deeply impressed with the importance of astronomical science. With this powerful aid, which would have been accorded to no other, he has been enabled to establish sure and regular communications with every part of the civilised world, and to face an expenditure which, under similar circumstances, no private individual would have ventured to undertake. He has thrown his whole weight into the scale of advancing science, and the effect has been the establishment of a great European astronomical republic, with a common feeling and a sense of common interests."

The *Astronomische Nachrichten*, in fact, contains the history of astronomical science for the last thirty years; it is the necessary complement and comment of almost every astronomical publication of value, and is the complete repertory of modern theory and practice, not of Europe, but of the civilised *world*.

Some very considerable works by Professor Schumacher have as yet not been published at all, or not completely so. The Danish arc of the meridian, the measure of the length of the simple pendulum from observations at Güldenstein in 1829–30, the determination of the standards of weight and measure, various chronometrical journeys for fixing longitudes, and numerous series of astronomical observations, are as yet in manuscript, but will probably be published before long.

Another most important service which Professor Schumacher rendered to astronomy was the assistance which he gave in training a large number of excellent men to calculation and the practice of observation. Gunlogsen, now professor in Iceland; Nissen, Deichgraf in Tondern; Hansen of Gotha; Clausen of Dorpat; Peters of Königsberg; and Petersen of Altona; were all chiefly formed in the school of Altona. Many others have resided at Altona, for longer or shorter periods, to profit by Schumacher's practice and

advice,—Olufsen, Ursin, Posselt, Selander, Von Fuss, Agaardh, Sievers, Neumann, Brorsen, Schmidt, Gould, &c. At his death, besides his son Richard, Dr. Olde, Sonntag, and Quirling, were qualifying themselves as astronomers under his direction.

Up to the commencement of the unfortunate disputes between Holstein and Denmark, Professor Schumacher's lot may have been considered as a very favourable one. The personal favourite and friend of his sovereign, surrounded by a cheerful family, highly esteemed by the most distinguished inhabitants of his own town and the adjoining city of Hamburg, directing the studies, practical and theoretical, of his young friends, and enjoying a widely extended correspondence with the most celebrated astronomers of Europe, his life was happily spent in the performance of his duties, and in enjoying very frequently, in his hospitable house, the personal visits of his numerous and attached friends. But latterly his position was greatly changed: the political troubles put a stop to the survey, and his feelings were greatly distressed by the quarrel of his native Holstein with the crown of Denmark, to which he had so many hereditary and personal obligations. The existence of the Altona Observatory was endangered, and even the continuation of the *Astronomische Nachrichten* put in doubt. In this critical emergency the astronomers throughout the world rallied for his protection. Almost every civilised country made, through its representatives, the most urgent requests to the Danish court that the observatory of Altona and its respected director should be spared and protected. Your Council addressed Lord Palmerston with great earnestness, and the cause of science could not have been entrusted to more able or energetic hands. His lordship strongly urged the deep interest with which this and other countries regarded the Professor, and obtained assurances from the Danish government that neither the Professor nor his establishment should be affected. Mr. Richard Parish of Hamburg, a very old and very dear friend of the Professor, supported him nobly through this crisis with his advice and sympathy, and with still more effectual means.

Though the Professor's constitution was naturally feeble, his regular life and careful attention to diet preserved him in a tolerable state of health; he was, indeed, not unfrequently indisposed, but his end was probably accelerated by distress of mind occasioned by these unhappy political quarrels. It would be hard to say what has been gained by either party, but the loss of many thousand valuable lives and of millions of wealth admits of no dispute.

Schumacher's natural refinement had, as we have already said, been cultivated by his association with the world; but he did not thereby lose his simplicity and kindness. At a first introduction, we are told that his manner sometimes appeared a little reserved, but this can only have been the case with perfect strangers;—at least the compiler of this notice, speaking from his own experience, would cite the Professor's manner as being exactly that which should belong to a man of the world, who was also a man of science; frank and open, and yet highly polished and cour-

teous. His friends (and they were very numerous) always found him a good-humoured, lively companion, full of anecdote, and an excellent listener. He was very fond of chess, but preferred looking on and discussing critical points to playing himself. He was intimately and deeply read on this subject, and maintained a large correspondence with the most celebrated players.

Nothing could surpass the kindness with which he attended to even unreasonable demands upon his time and attention. His industry enabled him to repair the loss, and his good-breeding subdued his impatience.

An incomparable husband and father, Schumacher's well-regulated mind was preserved in all its purity through life. He does not seem, so far as we learn, to have had any ill-wishers, though probably he may have been envied in his more prosperous time and good fortune. We fear that his generosity to others, and his delicacy about money-matters, which he carried to excess, may have indeed left his character the chief as well as the best inheritance to his family. In astronomical science his death has caused a void which cannot be supplied, and his bright example proves that scientific usefulness and even reputation may depend as much on goodness of heart as on those qualities which are purely intellectual.

The principal scientific Works of Professor Schumacher already published :—

Géométrie der Stellung von Carnot, übersetzt, &c. Altona. Band I., 1807 ; Band II., 1810.

De Latitudine Speculæ Manhemiensis. Havniæ, 1817.

Astronomische Hülfstafeln, 1820–1829. Copenhagen.

Samlung von Hülfstafeln. Copenhagen, Heft I., 1822 ; II., 1825. The second part was also published under the title of *Tafeln zür Reduction der Histoire Céleste.*

Ephemerides of the Distances of Venus, Mars, Jupiter, and Saturn, from the Moon's Centre. 1822–1831. Copenhagen.

Schreiben an Dr. W. Olbers in Bremen, &c. Altona, 1821. Containing a description of the apparatus employed in measuring the base at Braack.

Astronomische Abhandlungen. 3, Bde, Altona, 1822–5.

De Latitudine Speculæ Havniensis. Altona, 1827.

Astronomische Nachrichten, 1823–1850.

There are also several papers in Zach's *Monathliche Correspondenz*, Lindenau's *Journal*, Gergonne's *Annales de Mathématiques*, &c.

Jahrbücher, 1837–1844 ; containing essays, disquisitions, and memoirs by the most distinguished astronomers of Europe.

By Bessel's direction, Professor Schumacher edited *Populäre Vorlesungen über wissenschaftlische Gegenstände von F. W. Bessel*, Hamburg, 1848, after the author's death.

John Frederic Trechsel was born March 4, 1776, at Berthoud, in Berne, of an ancient but not rich family. He distin-

guished himself both by talent and energy at the school of his native town, from whence he proceeded, at the age of thirteen, to Berne, as a student in theology. As a resource, he was obliged to become a private teacher, in which capacity he made acquaintance with others of the same occupation, and in particular with two, who have since been known as the distinguished philosophers Herbart and Hegel. A fondness for metaphysical inquiry, and a predilection for the study of Kant, just then beginning to be generally known and appreciated, procured him the notice of Professor Ith, who recommended him to make a serious study of mathematics, as the indispensable foundation of all solid science. This he did under the celebrated Tralles, but without losing sight of his intended profession.

The revolutionary troubles of 1798 made a soldier of him, and he served as a volunteer against the French. After the capitulation of Berne and the proclamation of the Helvetic republic, he was examined and ordained. He was then still engrossed with public events, and would probably have either taken to political writing or have entered as chaplain into the Swiss legion in British pay, had not the battle of Zurich and its consequences damped his hopes. He abandoned his projects, and returned to the profession of teaching. After some time, he and two of his friends formed an institute for scientific education at Berne, which succeeded eminently, and obtained great reputation.

At the restoration of federalism, the new Bernese government founded an academy for the higher education in science. In 1805, at the first institution, Trechsel was called to the chair of mathematics, and seven years afterwards to that of physics. While thus engaged, he received various marks of esteem and confidence from the government. He was employed, in 1809, to examine and report upon the system of Pestalozzi, and afterwards upon that of Bell and Lancaster, as introduced at Fribourg by his friend Père Girard. He received the rights of citizenship, and was appointed chief librarian at Berne.

In 1812 he determined the latitude of Berne with precision, in conjunction with two French officers. This operation gave rise to the establishment of an observatory at Berne, the well-determined position of which made it a fundamental point in all the geodetical operations afterwards executed in Switzerland. In 1811, Trechsel had been appointed to superintend the triangulation of the Canton of Berne; and in this task, especially in its connexion with the French and Italian surveys, he passed several years. In 1816 and 1817 he was employed in establishing the level of the waters of the Jura, during which his health suffered by exposure in a marshy country. In 1819, the government of Valais employed him in the investigation of the causes of the inundation of the Val-de-Bagne, and the means of security for the future. From 1820 to 1830 he was mostly employed upon the weights and measures of Switzerland, and the introduction of the metrical system.

The change which took place in Switzerland after the French

revolution of 1830 produced its effect upon Trechsel's position, as upon that of other friends of the old order of things. It was with some difficulty that he procured permission to retain his chair when the academy was changed into a university. The anxiety which this altered state of things gave him, though comforted by the regardful attention of his colleagues, and, in the end, of the government itself, accelerated the failure of his constitution. He retired in 1847, and his resignation was received in a manner satisfactory to his feelings. A short interval of amendment soon followed, during which he employed himself in his post of public librarian. A cold, caught while returning from the country on a damp autumn evening, was followed by fever, of which he died, November 26, 1849. He was of full stature, of handsome and gentle countenance, and of a generous, benevolent, and energetic character—unwearied in his public labours, distinguished as a teacher both by will and power to explain, and by skill in experiment and demonstration. In every point of view his memory is highly regarded by his countrymen.

Trechsel published the following works:—

1. *Ueber wissenschaftliche Erziehung*, in Bezug auf die wissenschaftliche Lehr-anstalt. Eine Eröffnungsrede. Bern, 1801.

2. *Ueber Verstandesbildung durch Geometrie.* Bern, 1802.

3. *Ueber die Abhængigkeit der Geistescultur von der sittlichen Bildung.* Bern, 1803.

4. *Ueber die Gründlichkeit im Studiren.* (Literar. Archiv. der Akademie zu Bern. Band 2.) 1808.

5. *Ueber das Ehrgefühl und die Bildung desselben.* (Ibid. Band 3.) Bern, 1809.

6. *Bericht über die Pestalozzische Erziehungsanstalt zu Yverdon.* Bern, 1810.

7. *Nachricht von der im J.* 1811, *angefangenen Trigonometrischen Aufnahme des Cant. Bern.* (Literar. Archiv. der Akad. zu Bern. Band 5.)

Notice sur la Triangulation exécutée dans le Cant. de Berne. Extraite de la Correspondance de M. le Prof. Trechsel, Directeur en Chef de ce travail, avec le Prof. Pictet; accompagnée du tracé des principaux triangles et d'un tableau de la position géographique et des hauteurs des stations principales. (Bibl. Univers. de Genève, Sc. et Arts, vol. x.)

8. *Sur la Comparaison de deux Théodolites*, etc. Extrait d'une Lettre de M. Trechsel, Prof. de Mathém. à Berne au Prof. Pictet. (Bibl. Britannique, vol. lix.)

9. *Notice sur un grand Nivellement exécuté dans une partie du bassin de la Suisse occidentale*, sous la direction de M. Trechsel, Prof. etc.; et sur les donnés préparatoires à un projet d'abaissement du niveau des lacs de Morat, de Neuchatel, et de Bienne, au moyen d'une rectification de l'Aar et de quelques rivières adjacentes. (Bibl. Univ. Sc. et Arts, Nouv. Série, vol. viii.)

10. *Notice sur les Travaux préparatoires à un projet de redressement du cours de l'Aar*, et en particulier sur la mesure de la

vitesse de cette rivière dans un grand nombre des ses sections. Extr. de la corresp. du Prof. Trechsel, avec le Prof. Pictet. Avec fig. Ibid.

11. *Beschreibung und Vergleichung bernischer Maasse und Gewichte.* Bern, 1821.

12. *Bemerkungen über Blitzableiter und über Blitzsohlæge* veranlasst durch einige Ereignisse im Sommer 1819, von F. Trechsel, Prof. (Naturwiss. Anzeiger der allg. Schweiz. Gesellschafter f. d. Naturwissensoh. 1819, No. 2. Gilbert. Annalen der Physic. Band 64. Bibl. Univ. Sc. et Arts, Nouv. Sér., vol. xi. xii. et 15.)

13. *Bemerkungen über Lapostolle's Blitz, und Hagelableiter aus Strohseilen.* (Naturwiss. Anzeiger, 1821, No. 1. Literar. Archiv. der Akad. zu Bern. Band 4.)

14. *Nachricht von der in den Jahren* 1821 *und* 1822, *in Bern errichteten Sternwarte.* (Bibl. Univ. Sept. 1822. Literar. Archiv. Band 5.)

15. *Ueber die Verbindung der Naturwissenschaft mit der Mathematik.* Bern, 1832.

16. *Mittel und Hauptresultate aus den Meteorologischen Beobachtungen in Bern von* 1826–1836. (Denkschriften der Schweiz. Gesellschaften für die Naturwissenschaften. Band 2.)

17. *Observations Astronomiques pour déterminer la Latitude de Berne*, faites en 1812 par le Col. Henry, le Command. Deloroz, et le Prof. Trechsel. (Ibid. 1850.)

18. *Sur les Ombres coloriées*, par F. Trechsel, fils. (D'après les données du défunt. Bibl. Univ. v. 31. Edinburgh New Philosophical Journal, by Jameson, vol. xvi.)

T. W. Hornbuckle was a native of Bedfordshire, and was educated at St. John's College, Cambridge, where he took the degree of B.A. in 1797, and was third in the list of wranglers. Having obtained a fellowship, he was appointed one of the assistant-tutors, and in due time tutor, which office he held during the long period of 17 years. In 1827 he retired from college, having succeeded to the rectory of Staplehurst, in Kent, where he passed the remainder of his life.

Mr. Hornbuckle was not raised to any post of high dignity in the Church, nor did he seek fame by any publications. But in the two stations which he occupied, as a college tutor and a parish priest, his name is associated with sentiments of respect in the minds of all who were acquainted with him. He had the honour of having Sir John Herschel among his pupils. By all of them he was highly esteemed, both for his ability and for his kind attention to them. In general society he was also very acceptable, being of a very hospitable and social disposition, and his conversation distinguished by good sense, and by a peculiar acuteness and readiness of wit.

He was twice married, and by the first marriage had two daughters, who survive him. His death took place in 1848. He may be accounted one of that class of able men who, placed either

by choice or by the force of circumstances in a limited sphere of action, have been content with the good opinion of those among whom they lived, leaving to others, more ambitious or more fortunate, the arduous task of endeavouring to transmit their names to a remote posterity.

Commander James Wolfe entered the navy in June 1814, from the East India Company's maritime service, and was employed in the Morgiana, Captain Sandilands, on the coast of Africa, and in the Adventure, Captain W. H. Smyth, in the Mediterranean, till the year 1823, when he passed his examination for lieutenant. In 1825 he joined the Blossom, Captain F. W. Beechey, and consequently was a partaker in the vicissitudes of that officer's interesting voyage round the world, which occupied a period of three years and a half. After obtaining his commission in 1829, he was appointed to several surveying-ships in succession, in each of which he acquitted himself meritoriously. In February 1843 he was promoted to the rank of commander and shortly afterwards commissioned to the Tartarus steamer, a vessel employed in the survey of the coast of Ireland. His excellent conduct in this department is attested by the various plans and charts which resulted from his operations, and were published by the Hydrographical Office of the Admiralty; especially those of the river Shannon, from its entrance up to Limerick; Upper and Lower Lough Erne; Bantry Bay; Bear Haven; and the Cove of Cork. He died on the 29th of November, 1849, at the age of 42.

Sir Lancelot Shadwell, Vice-Chancellor of England, was born May 3, 1779. He was educated at Eton and St. John's College, Cambridge, where he highly distinguished himself. He was called to the bar in 1803, and after a successful career, and a short occupation of a seat in Parliament, was promoted to what was then the sole Vice-Chancellorship, in 1827. After a long and honourable discharge of the duties of this high office, in which his manners made him highly popular, he died on the 10th of April, 1850. Sir Lancelot Shadwell retained to the last his taste for science and literature, in both of which he distinguished himself in early life. In would be out of place to describe his legal life or to eulogise his judicial merits, but he was well known in the world as a scholar and a gentleman; and your Council regret that, so soon after his admission as a Fellow of this Society, they should be called upon to pay this tribute to his memory.

Captain Owen Stanley, eldest son of the late Bishop of Norwich, was born on the 13th of June, 1811. After being educated in the Royal Naval College at Portsmouth, he entered the navy early in 1826; and in January 1830 joined the Adventure, commanded by Captain Philip Parker King, who was then employed in surveying the Straits of Magellan. After receiving his commission as lieutenant, he was appointed to various ships on the

Mediterranean station; and while in the Mastiff, with his former shipmate Captain Graves, he assisted in surveying the Grecian Archipelago. In May 1836 he was selected to take charge of the astronomical and meteorological departments of the polar expedition under Captain Sir George Back, in the Terror bomb. On returning from this harassing attempt in the autumn of 1837, he was appointed to the Britomart of 10 guns, in which vessel he aided in forming a colony at Port Essington, made a track survey of the Arafura Sea, and surveyed various harbours in New Zealand.

Captain Stanley attained post rank in September 1844, and two years afterwards was appointed to command the Rattlesnake, a small frigate fitted for surveying, and destined to explore the reefs and banks between the east coast of Australia and New Guinea. To this great work he devoted himself most diligently, and made various discoveries of importance: but the arduous nature of the service, the oppressive heat of the climate, and some very severe family afflictions—especially the deaths of his brother and father in a brief interval of time—preyed on his mind, and acting upon a system already much debilitated, brought his valuable life to a sudden close. He expired on board his ship, in Sydney Harbour, on the 13th of last March, at the early age of 38 years; and his remains were interred in the cemetery of that town with impressive funeral honours.

Captain Stanley on this expedition, as indeed he had always done, devoted his whole time and energy to the fulfilment of the onerous duties intrusted to him by the Lords Commissioners of the Admiralty; he was fond of scientific pursuits generally, beyond the usual acquirements of an ordinary nautical surveyor,—a class of which he proved himself, by his works, so able and so distinguished an example.

William Galbraith was born at Greenlaw, in Berwickshire, on April 23d, 1786. His parents were respectable, but not opulent, and they gave their son a good elementary education in the parochial school of his native place. He afterwards attended a school at Polwarth, near Greenlaw.

In 1807 he was appointed master of the parish school of Eccles. He did not consider the period of his residence there as the happiest one of his life. In Scotland the minister of a parish has the official superintendence of the education of the children in the parish school, and is chairman of the committee annually appointed by the presbytery to examine and report upon its state. In these examinations Mr. Galbraith felt himself in collision with the clergyman, and the result was annoying to his feelings. However, by steady perseverance he surmounted all his difficulties, and became the most popular teacher in the district. Pupils came to his school, not only from the neighbouring parishes, but from the surrounding counties. Dr. Rutherford, a member of the Council of this Society, walked twelve miles a-day, for some time, to enjoy the benefit of Mr. Galbraith's instructions.

In 1816 he resigned his situation at Eccles, and immediately settled in Edinburgh as a teacher of mathematics and nautical astronomy. His professional engagements in Edinburgh did not at first occupy the whole of his time, and he entered himself as a student at the University. After passing through the regular course of study there, he took his degree of A.M. in April 1821. He also attended the divinity class, and about 1832 he was licensed as a preacher by the presbytery of Dunse.

He married in 1833; and his widow is now left with their only child, a daughter, to struggle with the world; their sole dependence being in the sale of Mr. Galbraith's extensive library and valuable collection of astronomical instruments.

His constitution was naturally good, and he scarcely knew what a headach was till the spring of last year, when his health began visibly to decline; and after slightly complaining for some months, he expired suddenly at his house on the South Bridge, about 12 o'clock at noon, on Sunday the 27th of October, at the age of sixty-four years and six months.

To mental powers of no ordinary kind Mr. Galbraith united the most unwearied application, which soon gave him a name among mathematicians, with many of whom he kept up a constant correspondence. Though mathematics, natural philosophy, and astronomy, were Mr. Galbraith's favourite pursuits, he was an elegant classical scholar: he read, with fluency and ease, French, German, and Italian, and was, besides, more than ordinarily conversant with the history and literature of modern Europe.

To Mr. Galbraith's science and industry Scotland owes the resumption of the trigonometrical survey, as during his holidays he made a series of most accurate observations of several points on the western coast; and having found that these points were from a mile to a mile and a half erroneously laid down in all our maps, he induced several public bodies to interest themselves in the matter, and in consequence of their representations and petitions the survey was resumed. At the last annual meeting of the Royal Scottish Society of Arts, the President spoke of Mr. Galbraith in the following terms:—

"I may mention that, in 1837, Mr. Galbraith received the Society's gold medal for his paper on 'The Erroneous Geographical Position of several Points in the Frith of Clyde;' which communication tended materially to expedite the order for resuming the trigonometrical survey of Scotland. In the same year he also received the thanks of the Society for a very interesting paper 'On an extraordinary Instance of Refraction.'"

As an accurate surveyor and an admirable teacher of mathematics and nautical astronomy, Mr. Galbraith has left no superior in Scotland; nor will it be an easy matter to supply the place which his death has made void, and which he occupied many years with so much honour and credit to himself, and advantage to his country. Among his more private friends he was highly esteemed for the simplicity and honesty of his character, and for the genuine warmth and kindliness of his disposition, and he will be long

remembered by them with the strongest feelings of regard and esteem.

The works of Mr. Galbraith are not numerous, but they maintain a high character among practical men. The publication by which he is best known is entitled *Mathematical and Astronomical Tables*. The first edition of this work appeared in 1827, and the second in 1834. These tables are preceded by a copious Introduction, in which is embodied much highly useful and practical information. Besides this and some other publications, Mr. Galbraith communicated upwards of thirty mathematical, geodetical, and astronomical papers to different scientific journals; many of them requiring much research and labour, and all of them evincing that their author was not only zealously devoted to the practical applications of science, but a distinguished and successful cultivator of every region and department of modern mathematics. A list of Mr. Galbraith's works and papers is here subjoined :—

1. Mathematical and Astronomical Tables. Edinburgh. 8vo. First edition, 1827. Second edition, 1834.
2. Barometric Tables, for measuring Weights by the Barometer. Edinburgh, 1833.
3. General Tables for Astronomical Purposes. Edinburgh, 1834.
4. Article "Observatory," *Edinburgh Encyclopædia.*
5. Trigonometrical Surveying, Levelling, and Railway Engineering. Edinburgh, 1842.
6. A new and much-enlarged Edition of Ainslie's *Land-Surveying*, embracing Railway, Military, Marine, and Geodetical Surveying. Edinburgh, 1849. 8vo.

In conjunction with William Rutherford, LL.D., F.R.A.S.

7. A new Edition of Bonnycastle's *Introduction to Algebra;* also, a Key to the same. Edinburgh, 1848 and 1849.

In the London Philosophical Magazine and Journal.

1. Remarks on the Experiments of the Pendulum, made by Captain Kater, M. Biot, &c., with some new General Formulæ for determining the true Figure of the Earth. September 1824.
2. Paper continuing the above subject. January 1825.
3. Remarks on the Velocity of Sound. July 1825.

This paper was translated into French, and published in the *Bibliothèque Universelle*, at Geneva.

4. On the Figure of the Earth. March 1826.

An abstract of this and some other connected papers has been translated and published in German, in a work on natural philosophy, by Gehler, at Leipzig.

5. Further Investigations on the Velocity of Sound. September 1826.
6. Same subject continued, with Remarks on the Experiments of Professor Moll of Utrecht. May 1827.
7. On the Determination of the Figure of the Earth; with

Remarks on the Solutions of Professor Airy of Cambridge. July 1827.

8. Determination of the Latitude and Longitude of the Observatory on the Calton Hill, by new Methods. April 1829.

9. On the Deviation of a Falling Body from the Vertical to the Earth's Surface; with Remarks on the Solutions of Emerson and La Place. November 1829.

10. On the Reduction of the North Polar Distances of Stars observed at Greenwich. May 1831.

In the Edinburgh New Philosophical Journal.

11. Barometric Measurement of the Height of Ben Lomond, &c. October 1828.

12. On the same subject. January 1831.

13. Same subject continued. October 1831.

14. On the Magnetic Properties of the Rock on the Summit of Arthur's Seat. October 1831.

15. Barometric Measurement of the Height of Cheviot, by Sir Thomas Brisbane and Mr. Galbraith. No. 27.

16. Review of Sir Howard Douglas on Military Bridges. April 1832.

17. Review of Sir Howard Douglas on Naval Tactics. November 1832.

18. Remarks on Borda's Geometrical Measurement of the Height of the Peak of Teneriffe. January 1833.

19. Formula for Trigonometrical Surveying. October 1833.

20. On Worleman's Correction of Middle-Latitude Sailing. April 1834.

21. Notice of a New Pocket Box-Circle, for making Observations at Sea or on Land; for which, on the Report by Professor Forbes and Mr. Sang, the silver medal of the Society of Arts was awarded. December 1836.

22. Essay on the Erroneous Geographical Position of several Points in the Frith of Clyde; for which the gold medal of the Society of Arts was awarded. December 1837.

23. Remarks on the Geographical Position of some Points on the West Coast of Scotland. January 1838.

24. On the English Arc of the Meridian. April 1843.

25. On the Tides and Dew-Point, January 1850.

26. On the Tides. April 1850.

In the Presbyterian Review.

27. Review of Young's *Elements of Mechanics*. July 1832.

28. Review of the *Mechanism of the Heavens*, by Mrs. Somerville. September 1832.

29. Review of Plana's *Theory of the Moon*. July 1834.

30. Review of Carlini's *Solar Tables*. September 1834.

IV. *In the Journal of Agriculture, published under the Patronage of the Highland and Agricultural Society of Scotland.*

31. Essay on Wheel-Carriages.
32. Same subject continued.
33. Essay on a Geological Survey of Scotland.

Mr. James Pettit was the son of a farmer at Bedford, at whose death he came to London, and followed the profession of music with great success; but having obtained introduction to some of the first families in the kingdom, he succeeded in an application to become a clerk in the Bank of England; in his leisure hours he devoted his time to the study of optics. He made a number of achromatic telescopes, some of which are much above mediocrity. He also studied medicine, and was passionately fond of mesmerism; bodily afflictions, and the number of years he held the situation of a clerk in the Bank, induced the directors of that establishment to grant him a retiring pension; upon which, besides other property he possessed, he lived in great suffering until his decease, which took place the 25th day of November, 1850, in the 76th year of his age.

Though some inquiry has been made, we have not been able to get any personal account of Lieut.-Col. Wilcox, late Director of the Observatory of Lucknow; but from his correspondence with one of the members of the Council, we can state some particulars of his scientific labours.

The Observatory of Lucknow was founded by the King of Oude on a considerable scale, and furnished with instruments of the highest class: a mural circle of 6 feet; an 8-foot transit; and an equatoreal of more than 5 inches' aperture by Troughton and Simms, with clocks by Molyneux. It certainly was the best-equipped observatory in India.

Colonel Wilcox took the direction of this establishment—at least he commenced his observations—about the middle of 1841; and we have good reasons for believing that he was both zealous and able in the performance of his duty. An extract from a letter, dated 1846, Jan. 7, is as follows:—

"It is time that I should tell you how we have been employed. Mr. Airy, very kindly, in reply to a letter which I wrote him on the subject, pointed out that we ought to take advantage of our more southern latitude to make a great number of daylight observations of the planets; and he thought that the clearness of our atmosphere might enable us to see the small planets better than you do in Europe. Whether we have succeeded in either of these points I am not quite sure. We have certainly made a great number of observations of the planets by day; but then we have to contend with a disadvantage belonging to the high range of our temperature—I am not aware, at least, that you experience it equally—the tremulous motion of the atmosphere, which occurs to so ex-

cessive a degree during the day, that I have frequently seen *Venus* jump away from the wire the full extent of her semi-diameter; and with regard to the smaller planets, although we can get on very well with *Vesta* and *Ceres*, *Juno* we have always found impracticable, and with *Pallas* we succeeded the first year only. Mr. Airy thought that as so much had been done elsewhere in star astronomy, I need not give much attention to it. Before, however, I received his letter, an expression in one of yours, in which you tell me that, although Mr. Taylor's places are good, I ought with my fine instruments to give better, had already given a bias to my views; and this was increased when I experienced some disappointment in accomplishing, as I would have wished, the objects chalked out for us by Mr. Airy. The consequence is, that I have made a great many observations of stars; and instead of limiting myself to two or three upon each, as Mr. Taylor had done, I took ten for my limit; and although some stars have not been observed so frequently, that number has been exceeded, I believe, with the major part. It is easier to observe than to reduce; and fifty stars, which were easily observed at night, take up by day more time than we have to spare for them. In observing with the mural circle, it is my plan to work hard for a limited space of time each evening, and I have three people employed — two to read the microscopes and one to write. One could not wish for better observers than our educated Hindoo lads turn out; and I believe that our transit observations — in which I take no part myself — will compete with those of any observatory. With the equatoreal I have done nothing more than to use the telescope for eclipses of *Jupiter's* satellites. I have observed but few occultations, on account of their requiring time for the previous computations; but the pillar on which the equatoreal is placed, and which was built before I took charge, runs up to so great a height, that a touch of the finger will make it vibrate, and a level resting upon it is altered 7″ on removing or applying the weight which moves the clock." Then follow some queries as to the mode of observing the small planets without illuminating the field.

The main object of the foregoing letter was to ask for information as to the mode of publication, and the probable expense. There is no printing-press at Lucknow, and Calcutta, the nearest place possessing a press competent to such a task, is 600 miles distant. The king, moreover, though willing to pay down at once a sum of 500*l.* or 600*l.*, demurred to a large *annual* expense.

The conclusion to which Colonel Wilcox inclined, was, to compress the work somewhat by leaving out the less important steps of the reduction; and to ask the Astronomical Society to superintend the printing of the work, either as a portion of their *Memoirs*, or in a separate form, at the king's expense.

In a later letter (1847, January 22), Colonel Wilcox says, "His Majesty has placed 600*l.* in my hands for printing the first three years' observations, separately, after which he is willing to grant 50*l.* or 60*l.* annually to have our *results* printed in the *Memoirs*,

if the Society will accept them. I should have been better satisfied with a different decision, and to have made over my papers to the Society; in which case I should have been relieved from the further trouble and perplexity of printing. Truly I do not know how to proceed. A press of my own, working under my own eye, would have many advantages; the first of which would be the saving of an enormous quantity of writing in making a complete copy; but judging by our printing in India, when executed by moderately experienced hands, I should fear that it would turn out very wretched indeed where experience is wanting, and we have not a press in all Lucknow. Calcutta, at the distance of 600 miles, offers little advantages over England; while to perform that most important and troublesome task of correcting the press, I suppose we should with difficulty find a capable person. Will you kindly assist me in my dilemma with any suggestions which your experience may afford? Were I to make over the papers to the printers of the B. A. Catalogue, or those of the Greenwich Observations, could I rely on justice being done? or would it be absolutely necessary to employ an intermediate party, and would the expense of so doing be large? I ought not to omit to state that one reason for preferring England is, that I would wish to make over the whole impression to the Society for distribution. I fear that with 600*l.* I have but barely sufficient, if indeed enough."

Colonel Wilcox then enters into some estimates of the expense of printing his observations for three years, 1841, 2, 3, upon certain data supplied by Mr. Richardson of Cornhill, and a comparison with the Cambridge volume of 1835, and concludes that the sum would be scarcely sufficient if the observations were given in the same detail as in the Cambridge volume. His calculation, indeed, which is only approximate, seems to carry the work to nearly 1300 pages.

Some preparatory inquiries were made in order to get Colonel Wilcox the necessary information. It was intended to recommend to him the form of the later Oxford volumes, as being sufficiently extended, and yet compact and elegant; but a good deal of delay occurred, and nothing was done before the report of Major Wilcox's death reached England.

In the latter end of 1849 the following letter was received from Dr. Sprenger, Principal of Delhi College:

"Lucknow, 14th Sept. 1849.

"My dear Sir,—You are probably informed of the death of Lieut.-Col. R. Wilcox, Astronomer to the King of Oude: it happened in October 1848. Two months ago, the king abolished the observatory, and the papers and instruments are in charge of a native officer, who neither knows English nor astronomy. Some years previous to the death of the late Colonel W. the king granted six hundred pounds for printing the observations. This sum is in trust of Mr. Wilson, of Ghazeepore, the colonel's executor and brother-in-law, and might still be made available for that purpose.

The observations for three years (1842, 1843, and 1844) are reduced, and might at once be printed; and it is likely that a beginning would have been made ere this, were the (British) Government of this country convinced of the utility of the undertaking. I have spoken on this subject with the Secretary to Government, and with the Resident of Lucknow; and it is with the sanction of this latter that I write to you. As you have been in correspondence with Colonel Wilcox regarding the publication of his observations, you are probably acquainted with the details; and if you think that it would be useful to publish them, and that they could be printed—the whole or in part—with the assistance of the above sum, or if you think it would be useful to deposit them in MSS. in your Society or in the Observatory at Greenwich, your Society have only to express their views and wishes in a letter to Colonel Sleeman, Resident at Lucknow, insisting on the utility of the observations; and I have reason to believe that he will obtain from the king and send you the MSS. and the sum which has been set apart for printing them. If the papers remain here, they will be destroyed by the white ants in a few years or months. Perhaps it would be useful if you would give some suggestions what might be done with the instruments. You will excuse my troubling you as a stranger.

"I am, &c.

"A. Sprenger.

"P.S. The mural circle and transit instrument are facsimiles of those at Greenwich."

To this the following reply was sent by order of the Council:—

"Royal Astronomical Society, London, Jan. 8, 1850.

"Dear Sir,—Your letter of Sept. 14, 1849, was brought before the Council of the Royal Astronomical Society at their first meeting. I am afraid the delay is partly my fault.

"The Society could not undertake to copy the Lucknow observations at their own expense in any case (we have, in fact, no funds except those that are barely sufficient to carry on the Society and to print our *Memoirs*), but there is a strong wish to publish valuable observations if the cost is defrayed by other parties, which seems here to be the case. The Astronomer Royal and I were directed to write to you, and to say that nothing can be resolved upon until the MSS. have been sent to this country and carefully examined. If they should be of sufficient interest, a responsible editor will be found among the members, and the work published as completely as the funds will allow. There will necessarily be a great deal of computation, which is drudgery, to be paid for. This is not, however, very expensive where the work is perfectly cut out. The editorship will be, of course, gratuitous.

"I am, &c.

"R. Sheepshanks.

"A. Sprenger, M.D., Principal of Delhi College."

Since this we have received no information from Lucknow respecting the observations or the instruments. It would be a great pity if either were allowed to be lost or wasted.

The new Transit-circle of the Royal Observatory of Greenwich is now mounted and in full use; in fact, the old transit instrument (Troughton's) is dismounted; and, since the beginning of the year, every determination in the observatory rests upon the observations made with the new instrument. The erection of this instrument will form, we may expect, an epoch in the history of astronomical mechanics. The object originally proposed was, to construct a meridional instrument carrying an object-glass of unprecedented size: the collateral objects which, it is hoped, have been attained at the same time, are, the securing of firmness and of accuracy to a degree not before known. Although some of the leading ideas in the construction of this instrument have from time to time been communicated to the Society, yet a brief history embracing the whole may not be ill-timed on the present occasion.

When the want of meridional instruments carrying object-glasses of larger aperture than those existing in the observatory had been stated by the Astronomer Royal, and recognised by the Board of Visitors, the next subject of consideration was, what form ought to be chosen for a new instrument? The least consideration of the form of Troughton's mural circle showed that it would be utterly unsafe to load such a construction with a telescope of the dimensions and weight it was proposed to attach to the new instrument. It was soon determined that the form of the ordinary transit is better adapted than any other to carry a weighty object-glass; and it was then obvious that a single instrument of the class of transit-circle might efficiently replace the two instruments (transit and mural circle) then in use. And it is to be remarked that the combination of the two functions in one instrument, when not accompanied with any positive inaccuracy, is highly advantageous, both as relieving the staff of observers, and as removing all doubts of the correspondence of the two elements observed to one and the same object. In no instance have the advantages of this instrument been proved more completely than in the great work of the late Mr. Groombridge. Of transit-circles there are two kinds; one, which may be called the English, in which the limb of the circle is firmly attached to the telescope; and one, which may be called the German and French, in which both the telescope and the central parts of the circle are united to the central parts of the axis, leaving the ends of the telescope and the circumference of the circle free. The Astronomer Royal preferred the latter, believing that with this arrangement the anomalous strains would be less, the circle more likely to preserve truly its circular form, and the flexure of the telescope more likely to follow the law which applies to the simplest cases of bending. The graduated circle being placed on one half of the axis, a circle of similar dimensions, intended to receive the action of the clamps, might advantageously be placed on

the other half. The general form of the instrument, therefore, may be understood as a telescope nearly 12 feet long, 9 inches in diameter at each end, and 18 inches diameter in the middle; carried by an axis 6 feet in length, which consists mainly of two cones whose bases are 18 inches in diameter, with pivots 6 inches in diameter, united at their intersection by a cube of 20 inches, with a 6-foot circle embracing each cone and attached to the side of the cube.

The next point was, the choice of material. It was thought proper to secure, if possible, three conditions; one, that the essential parts of the instrument should be in as few pieces as possible; the second, that the pivots should be in the same piece with the axis to which they are attached; the third, that the pivots should be hard. All these conditions were obtained by the adoption of cast-iron, the pivots being hardened by the process termed *chilling*; the telescope with its axis and pivots are made in only four pieces. Each of the circles is cast in two pieces, one cast embracing the radii or spokes, and one cast applying to the ring only.

The pivots rest upon chilled iron V's, which are solidly bedded, without any adjustments, each near to the centre of its pier. The mass of stone in the two piers exceeds 50 tons.

As an instrument of this ponderous character (weighing about a ton) could not easily be reversed, the following method is adopted for determining its line of collimation. Two collimators (5-foot telescopes, with $3\frac{3}{4}$-inch object-glasses) are planted on solid piers, one to the north and the other to the south of the instrument; and a mechanical apparatus is adapted for raising the instrument (keeping its ordinary counterpoises in their usual action), so far that the collimators can view each other. In this state a nearly vertical wire in one collimator is adjusted, by a micrometer-screw, upon a nearly vertical wire in the other; then the instrument is lowered, and the collimator-wires, as seen in its telescope, are used as opposite marks at an infinite distance. This method is found to be susceptible of very great accuracy. As the application of a level would be impracticable, the image of the middle transit-wire, as seen by reflexion in mercury, is made to coincide with the wire as seen directly, and the comparison of this position of the wire with the position for collimation gives the inclination of the axis. For these operations it has been found convenient that the whole system of transit-wires should be carried by the micrometer-screw.

The arrangements for these important adjustments were considered to be adapted, not only to extreme accuracy of result, but also to great facility of arriving at it; and, in point of fact, the determination of the line of collimation, and of the inclination of the axis (when the air is tranquil), are easier with this large instrument than with smaller instruments. Yet, after the completion of the instrument, and when it was too late to make an alteration without completely remaking the instrument, it was pointed out by Mr. Simms that the most troublesome part of the operation (the raising

the instrument in order to allow of the verification of the position of one collimator with respect to the other), might have been completely avoided. It was only necessary to leave a hole of 4 inches diameter through the central cube of the instrument, and then, by placing the telescope in a vertical position, one collimator would at once view the other. It is to be wished that this suggestion may be adopted for any future instrument constructed on the same general plan.

To determine the error of form of the pivots, a good 6-foot object-glass, of 3 inches aperture, is permanently fixed in one pivot, and a ghost-apparatus in the other pivot at the focus of that glass, constituting, in fact, a collimator revolving with the axis of revolution of the transit. This collimator is viewed by a 7-foot telescope, solidly planted on external piers; and the measures of the apparent movements of the collimator-point in the horizontal and vertical directions, made by means of a micrometer in the 7-foot telescope, give the elements for determining the form of the pivots. They are found to be extremely good.

The use of the graduated circle in combination with the internal micrometer, for the determination of zenith distances, is precisely the same as in the old circle, according to the practice of several years' standing at the Royal Observatory. The zenith point is determined, either by observing the image of the wire by reflexion in mercury, or by observing stars by reflexion. The mercury trough contains more than 50lbs. of mercury. It was necessary to construct a large apparatus which should carry this trough constantly in a horizontal position, through a considerable distance in the north and south direction, and through a small distance in the east and west direction. It was also necessary to arrange for easy transportation of the mercury to and from its store. All these purposes have required special mechanical arrangements.

In alluding here to the graduated circle, a peculiarity of its construction may be mentioned which was designed in the first conception of the plan of the instrument. In order to avoid the very great labour of reading microscopes on different parts of the limb of a 6-foot circle (the eye-ends of the microscopes usually occupying a circle of more than 7 feet in diameter), it was planned that the microscopes should pass in a diverging conical arrangement through the stone pier that carries one pivot of the axis; and thus the eye-ends of the microscopes are contracted into a circle of less than 2 feet in diameter, while at the same time the utmost stability is secured for the microscopes. And in order to avoid the trouble of illuminating the ordinary pierced reflectors, and the difficulty of adjusting them, it was planned that a single light in the line of the axis, and not far from the centre of the circle formed by the microscope eye-ends, should give light (without the intermediation of any reflector) through other holes, bored through the stone pier, upon those parts of the circle to which the microscopes are directed. And as the axis of each pencil of light and the axis of the corresponding microscope are inclined to each other several

degrees, it was necessary for bright illumination that the normal to the metallic surface of the divided limb should bisect the angle formed by those two axes; and thus that the divisions of the limb should be cut upon an internal cone or dished surface. The whole of this arrangement is eminently successful; the illumination and the facility and accuracy of reading probably surpass anything of the same kind that has ever been seen before.

It was thought highly important that means of permanent character should be provided for the examination of the accuracy of the graduation. Five additional holes for microscopes, accompanied with five corresponding holes for illumination, were accordingly bored through the pier. By means of these, the divisions have been examined to every degree, and the result is most satisfactory. Means are also provided for the examination of every division of 5′, but they have not been used, as there does not appear to be any probable irregularity of small portions which demands this scrutiny. It is proper to mention that the circle was divided on Mr. Simms' dividing engine; and that Mr. Simms, in order to give the best possible chance of accuracy, had the division effected at night, when the ground might be supposed to be least disturbed.

The absolute flexure of the telescope was determined by fixing a mark in its object-end and a 3-feet object-glass in the central cube, and observing the image of the mark with eye-end north and eye-end south. It was thus found that each end drops about $\frac{1}{1900}$ of an inch, or about 3″, as viewed from the centre. It is, however, the difference only between the two drops which affects astronomical observations. For determining this, advantage has been taken of the two collimators. A nearly horizontal wire in one is adjusted upon a nearly horizontal wire in the other, and then the apparent angular distance of these wires is observed with the telescope of the instrument and the graduated circle. The astronomical flexure of the telescope appears to be only a small fraction of a second.

Among minor arrangements it is proper to state, that, by a very simple contrivance, the same light which is commonly employed to illuminate the field is made to illuminate the wires in a dark field, no other movement being required than merely continuing the motion of the rod by which the field-light is graduated. The advantage of this construction has already been felt.

Your Council have thought it desirable to enter into these details at some length, because they consider that they may have an importance greatly exceeding that of the mere construction of a new instrument of the National Observatory. The instrument in question is a specimen of the kind of changes which may be anticipated as necessary in the increase of dimensions likely to be given to the object-glasses of telescopes. It presents an instance also of the advantage of sometimes having recourse, for the perfection of an instrument of science, to a branch of art scarcely employed on it before; for it is to be observed, that the greater part of the work in the construction of this instrument is engineers' work, and that

it could not have been intrusted to any other class of artificers. Even their general skill would have been found insufficient unless aided by the great improvements in the construction of modern engineers' tools, and, above all, by the devotion of Mr. May's personal attention to the instrument. On the other hand, nothing but the nicest work of the dividing engine could have ensured the accuracy of gradations, of micrometer-work, and of optical work, which are found in this transit-circle. On one of these points the Astronomer Royal acknowledges his obligations to the talent and zeal of Mr. Simms; and so far as the graduations are concerned, it is probable that no other dividing engine exists which would have fulfilled the conditions required.

The preparations for using the American method of recording transits, to which the Astronomer Royal has once called the attention of this Society, are far advanced, but not sufficiently so to enable us to give any account of their actual use. The preparation, also, of an instrument on the plan suggested by the Astronomer Royal, denominated the Reflex Zenith Tube, is advancing, the object-glass of the former transit being used for it.

Before dismissing the instruments which have for thirty years sustained the reputation of the Royal Observatory, it is proper to remark that they had in some measure lost their credit in the estimation of the persons who were most closely concerned with them; and the steps by which the observers have been led to this, in regard at least to the transit, are curious and instructive. When the altitude and azimuth instrument (or altazimuth as it is now called) was mounted, it was intended that its zero-point in azimuth should be determined solely by observations of stars in azimuth, the corresponding time being found by comparison of the altazimuth-clock with the transit-clock. Great discordances were found among the resulting zero-points, and after clearing off several causes of error there remained but two possible explanations of the discrepancies which remained, namely, either that the horizontal circle was unstable, or that the observation of time at the transit-instrument was bad. A 25-foot object-glass (formerly used for the zenith-tube) being at the disposal of the Astronomer Royal, it was mounted as a collimator for the altazimuth; and thus there were means of comparing three different elements, namely, the meridian-direction as given by the transit-observations, on the assumption that the transit-instrument is good, the meridian-direction as given on the assumption that the horizontal circle is steady, and the meridian-direction as given on the assumption that the collimator is steady. The close agreement of the two latter results have given a presumption amounting to moral certainty that the fault is entirely in the transits; and upon examining the constants of the transit-adjustments in many cases of conspicuous discordances of zero-points of azimuth in the altazimuth, there has been found (the Astronomer Royal believes in every instance) something suspicious in the adjustment-determinations, especially in later months, in the collimation of the transit. The Astronomer Royal fully hopes that

these sources of error will be greatly diminished, or even entirely removed, in the use of the new transit-circle.

At Oxford, Mr. Johnson is busily engaged in the completion of the circumpolar catalogue.

Almost all Groombridge's stars, which can be identified, have now been reobserved. The few which are not to be found are generally those which Groombridge observed only *once*. The new catalogue will contain nearly 2000 additional stars. It is expected that the work will be completed in the course of the present year, and be ready for publication in 1853. Some progress has been made already in its reduction to the epoch 1845. The Society is aware that the personal force of the establishment is not more than sufficient to grapple with this work alone; consequently, no definite course of observation has been begun with the heliometer.

Mr. Johnson devoted the early part of the last year to the study of the instrument, and to its manipulation. He sees no reason to mistrust its powers. Probably it will be found more efficient in measures of larger distances—such, for instance, as exceed 4″ or 5″—than in smaller ones; but this will not detract from its value in that class of researches in which it will be principally employed.

An inconvenience is at present experienced in a little displacement of the half-object-glasses; in consequence of which a single image can never be obtained. This is an adjustment which probably it will always be difficult to effect rigorously, and, if effected, would be liable to change. At present the displacement is inconveniently large. No doubt, when the instrument comes to be regularly worked, this may be remedied.

An application has been made to the Radcliffe Trustees to increase the personal establishment, more nearly to meet the present wants of the observatory. Their answer is expected very shortly. The application was to have been made last summer. It was delayed by a circumstance for which the trustees are not responsible. The melancholy death of Sir Robert Peel was a cause of further delay.

In mentioning the name of this distinguished statesman in connexion with the Radcliffe Observatory, we cannot pass unnoticed the interest he took in its affairs—an interest far more active and beneficial than arose from mere official connexion with it as one of its trustees.

He was the first to suggest the acquisition of the heliometer. The erection of the meridian-circle—of the new transit-instrument—the purchase of the excellent library of the late Mr. Rigaud—the annual publication of the observations,—are all events which mark the period of his trusteeship. Nor was it to its more important concerns that he confined his attention: no suggestion which tended to increase the efficiency or public utility of this observatory ever failed to receive the benefit of his advice, encouragement, and support.

It was the intention of himself and of his colleagues to have visited

the observatory, in company with a number of eminent scientific men, for the purpose of inspecting the heliometer; and on the morning of the day on which he met the fatal accident he spent some time in giving the necessary directions for this visitation, appointing a day, and naming the persons whom he wished to be invited.

The operations of the Cambridge Observatory have settled down into a course which Mr. Challis hopes will be continued for a long time, experience having shown that the most effective work in astronomy is done by adhering steadily to a fixed plan. The sun is constantly observed; the moon and culminators with the moon are observed for the purpose of contributing something towards the determination of terrestrial longitudes; a large list of zodiacal stars, situated within 5° N. and S. of the ecliptic, to the 9th magnitude inclusive, have been catalogued for observation, to serve as reference-points for equatoreal observations of the recently-discovered planets: many of the moon-culminating stars are included in this list. The observations of these zodiacal stars are proceeding at a steady, but not rapid rate. The recently-discovered planets are observed as often as possible on the meridian, and when nearer quadratures they are followed with the Northumberland equatoreal. The pursuit of these bodies in extreme positions is often troublesome, on account of its being necessary, for want of sufficiently extended ephemerides, to compute additional places from the elements. The older planets, being well taken care of at Greenwich, are not observed. Comets, especially those of short period, are attended to. Occultations of fixed stars and planets by the moon, solar eclipses, and transits over the sun's disk, are observed at every available opportunity.

Faye's Comet was observed on Nov. 28 of last year, on its first return since its discovery in 1843.

The sixteenth volume of *Cambridge Observations*, containing the meridian observations of 1844 and 1845, was published at the end of last year.

Another volume of the Edinburgh Astronomical Observations, that for 1843, has appeared since our last Report; and another is in progress, containing the rest of the observations of our late lamented Fellow, Professor Henderson, up to his demise in November 1844: appended to these will be the observations made since then up to July 1847, when the repairs of the building were commenced. These latter observations are not very numerous, being intended chiefly to secure as many moon-culminations as possible, especially those of the second limb: they will not, therefore, materially enlarge the present volume; and having been made with the instruments in precisely the same state as they were in Professor Henderson's time, may not improperly be included with his. But when the extensive repairs of the building were completed at last in 1848, such radical alterations were made in the instruments as to mark that epoch, rather than November 1844, as the commencement of the new series under the present astronomer.

Before, however, commencing with his own observations, Professor Piazzi Smyth wishes to publish an extra volume, giving a *résumé* of the whole of the planetary observations made by his predecessor; and especially a catalogue of stars, derived from the numerous excellent observations made between 1835 and 1847. There can be no doubt of the value of such a list, even of the larger and better known stars; and it becomes still more important with the smaller and unknown ones, which, forming so large a portion of the whole, would require the mean places of the stars to be accompanied in this publication with the constants for reduction to the apparent places, if this, the first Edinburgh catalogue, is to be of real and abundant practical use to working astronomers.

The preparation of such a work would, however, be a task of no small labour and time under the ordinary circumstances of an observatory establishment, consisting, as the Edinburgh one does still, of no more than an astronomer and one assistant; but a new circumstance has occurred, which makes the work almost impossible to be performed within any reasonable length of time, unless another assistant be added to the establishment.

The Edinburgh astronomer holds the position of Professor of Practical Astronomy in the University of Edinburgh, and is expected to lecture in the college on that subject for half the year; hitherto, however, this has never been done, even from the very foundation of the chair in 1770. With a mural circle, transit instrument, extra-meridian telescope, and some meteorological instruments to attend to, and with only one person to assist in all this, it is evident that Professor Henderson could spare no time from the observatory, if that work was to be done well; and he seems to have preferred to do the observatory half of his duties well, rather than that and the college half imperfectly; add to which, there was no apparatus by which the lectures might be illustrated, and no funds for supplying it either at the college or observatory.

Professor Piazzi Smyth—finding that public opinion was decidedly in favour of the lecturing being commenced, and being anxious to prove or disprove by actual practice the compatibility of the conjoined offices, or at least to try to do all that was expected of him, and having been further assisted by an opportune loan from our worthy and liberal Fellow, Dr. Lee of Hartwell, of a large quantity of instruments and apparatus—began a course of lectures on practical astronomy at the beginning of the present session. The success, as judged of by the number of students being more than was expected, seems encouraging. But after three months' trial of his new duties, and having three months more to accomplish before the session terminates, the Professor feels sure that a similar employment every year must materially injure the observatory, and that there is danger of its subsiding into little more than an educational establishment, unless he has additional assistance in carrying on the work of observing and computing on the Calton Hill.

At the observatory of Durham, Mr. Carrington, of Trinity College, Cambridge, was appointed astronomical observer in October 1849. From thence to May 1850, the principal work was done in the meridian. Since that time equatoreal work has been almost exclusively followed, as the most suitable occupation of a minor observatory. The results have from time to time appeared in our *Notices*. A chronometric comparison of longitude is now carrying out, and during 1851 the asteroids will be carefully followed. It has been suggested that it may soon become desirable to prearrange some division of labour in the case of the asteroids; and the Council think it advisable that this suggestion should be known and discussed.

Recent and satisfactory information has been received from Mr. Maclear. Now that the laborious and dangerous service of the measure of arc of the meridian is finished, the duties of the observatory of the Cape of Good Hope have resumed their natural course. Among the memoirs which were briefly announced in the *Monthly Notice* of December, is a full and particular report of Mr. Maclear's proceedings up to last July. It is not necessary here to enter into any detail with respect to this valuable document, as it will very speedily come before the world in a proper shape. The committee on Mr. Maclear's memoirs reported, that they would be a desirable acquisition to our quarto volume, but that it was not prudent nor our practice to print the work of a *public establishment* at the expense of the Society. The Astronomer Royal undertook to bring the matter before the Lords of the Admiralty, who consented with their usual liberality to defray the cost. We have many times had cause to bring the judicious kindness of their lordships prominently before you; and we may, perhaps, be allowed to remark (if any non-astronomer should be disposed to cavil at the gift), that the public thereby gains a guarantee for the sufficiency of the matter, a competent superintendence for the publication, and a wider circulation than could otherwise be commanded: all which is a carrying out, at no extravagant cost, the principal object for which the Cape Observatory was founded and is kept up. We think that the confidence thus shown in us is exceedingly gratifying, and we trust that you will feel so too. No time will be lost in passing Mr. Maclear's memoirs through the press, as part of the twentieth volume; and they will appear in a separate form very shortly. Mr. Maclear has sent, still more recently, a very valuable series of observations for determining the parallax of α *Centauri*. He has undertaken to re-examine the southern stars of the British Association, which are still very imperfectly known beyond the moderate number observed by Fallows, Johnson, and Henderson, and we have received two contributions to this inquiry.

It will be seen from the December *Notice*, that a somewhat similar revision of the southern heavens forms a large part of Lieut. Gilliss' stock-work during his residence in Chile. We wish the zealous director of this spirited expedition all the success he assuredly deserves.

We have not as yet received much information directly from Madras, but yet enough to prove that Captain Jacob is zealously and actively employed in his vocation. He is, among other things, engaged in examining and perfecting a catalogue of those stars which are best observed in his latitude. This is, of course, a long and heavy piece of duty, and perhaps the meridional instruments at Madras are not of the highest class,* but careful observations can always be made to furnish good results. Captain Jacob is of opinion that his geographical position naturally suggests planetary observation, and that with a large reflector on the Nilgherry Hills he would be more favourably placed for such observations than any one else. An application has been made to the East India Company for this purpose, but as yet without success. In the meantime Captain Jacob is making, from his own resources, a reflector of 2-feet aperture, to be equatoreally mounted with clockwork, so that he will be equipped for the service if he should obtain leave to execute it. Captain Jacob is also actively engaged in the measurement of α *Centauri* and other double stars, and in the computation of their orbits. His own large refractor by Lerebours is mounted equatoreally, and in a temporary manner, on the roof of his house, but it is probable that this instrument will be added to the observatory.

The observatory of Liverpool has figured very conspicuously in the records of our proceedings in the past year, and has fairly and honourably earned its European reputation. In the determination of extra-meridian phenomena, which do not fall within the range of a wire-micrometer, the Liverpool equatoreal is, we believe, at present unmatched. Such is the truth and steadiness of the mounting, that Mr. Hartnup can almost always employ stars of comparison from the Greenwich 12-year catalogue, and thus produce *at once* complete and accurate determinations. It must be avowed that the manipulation of this instrument is exceedingly laborious; but this is not a weighty obstacle to a skilful and zealous observer. We have great satisfaction in repeating the opinion expressed in the Report of last year, that "the determinations of the planets and comets made at this observatory would do credit to any establishment and to any instrument."

Last year Mr. Hartnup was a good deal engaged in assisting Professor Bond in his interesting chronometrical determination of the longitude of Cambridge observatory, U.S. "The final mean from 175 chronometers, duly reduced, &c., makes this longitude $4^h\,44^m\,30^s{\cdot}1$ west of Greenwich," a result which is probably not 1^s in error. Professor Bond hopes to obtain a still more accurate result, as the observations seem to indicate errors which may perhaps be eliminated by still greater precautions. The Professor proposes "to provide during the winter about 36 of the best chronometers, to have them thoroughly tested in temperature and well adjusted in

* Would it not be possible to procure for Madras the instruments of Lucknow, as that observatory is to be abandoned?

every respect, and to commence the exchanges between Cambridge, U.S., and Liverpool about June 1, 1851; to secure a separate state-room on board the steamer, and to have a competent person to take charge of the chronometers while on ship-board, to wind them up, note the differences every day, keep a journal of the temperature, barometric pressure, inclination of the vessel, and in short to attend to every particular which may be considered likely to affect their rates on ship-board." The Professor, in very handsome language, thanks Mr. Hartnup for his former co-operation, and requests its continuance in the new series.

Mr. Johnson has furnished Mr. Hartnup with a list of thirty-eight double stars, which he wished to have observed by the wire-micrometer, &c. of the Liverpool equatoreal, for comparison with measures made by the Oxford heliometer. Bad weather and the observation of the small planets have hitherto prevented Mr. Hartnup's observations extending beyond fourteen of these objects, but he purposes taking the matter up again as early as possible.

Besides the astronomical and chronometrical departments, the Liverpool Observatory is well supplied with meteorological instruments, and Mr. Hartnup has recently presented the results of five years' observations, ending December 31, 1850, to the Literary and Philosophical Society of Liverpool, who have requested permission of the Town Council to be allowed to publish the same.

Chronometers are tested at the observatory, as already described in former Reports, and with better means than any establishment, except Greenwich, enjoys. The assignment of the rate which corresponds to various temperatures enables any careful person to correct the defective compensation of his timepiece without sensible error, and must add very greatly to the accuracy of its indications. We trust that the importance of this part of the Liverpool Observatory will be felt more and more. It is a positive crime to neglect any feasible mode of increasing the security of navigation; and this is one which scarcely occasions any extra trouble.

We should be glad to learn that other ports had followed, even a long way off, the example of Liverpool, and enabled the seaman to prove the goodness of his chronometers, and to learn their errors and rates with scrupulous exactness. Southampton is at present furnished with Greenwich time by Mr. Drew, and possibly a similar advantage may be found elsewhere; but for perfect security and satisfaction, a regular establishment and observer are required, and this may be on a very modest scale, yet perfectly effectual.

The observatory of Mr. Cooper, of Markree Castle,— undoubtedly the most richly furnished private observatory known, — is worked with great activity by Mr. Cooper himself and by his very able assistant, Mr. Andrew Graham. It is understood that this observatory is at present chiefly devoted to completing an extensive and accurate series of star charts. But Mr. Graham has also found time to introduce his planet *Metis* to the astronomical world. He is, so far as we remember, the only astronomer who has discovered a planet, and undertaken the computation of her orbit

and the correction of her irregularities. The accordance between his observations and his last set of *Elements* shows that *Metis* is already amenable to her master's hand.

The observations for restoring the Standard Yard, and for determining a large number of accurate copies, have been pursued with some activity and with tolerable success; though, as usual, not without contrarieties. Having obtained what seemed a very close approximation to the imperial standard, Mr. Sheepshanks, with the aid of Mr. William Ellis and Mr. William Simms, junior, had many bars divided and compared in the course of last summer, the season most favourable for the operation. For the earlier comparisons a bar was used, in which the divisions were made, not by cuts or scratches, but by slightly separating the two halves of a cylinder split down the axis, which cylinder was inserted at each end of the bar. The improvement, however, made in the illumination showed that this kind of division was not practically required, and a bar was selected (one temporarily marked 12), which, according to the existing data, was sensibly equal to the lost standard. All the other observations of 1850 were made with No. 12 as the term of comparison, and No. 12 was itself carefully compared with Kater's Royal Society's Scale, and with Colby's Iron Bars, 1 A and 2 A. These last comparisons, which were exceedingly discordant, seemed to show that Bronze 12 was $= 36^{in}\cdot000048$ of the Imperial Yard.

As this was, on the whole, as good a result as the subject deserved (for it must be kept in mind that there is no accurate determination connected with the lost imperial yard, nor any trustworthy copies of it), all the observations were reduced in agreement with this value of Bronze 12; most of the bars, indeed, were compared directly with it. The previous term of comparison, viz. the bar with the split cylinder division, having been compared carefully with No. 12, it was believed that the bars were fairly determined *inter se*, though there might still be a little doubt as to their exact relation to the lost standard; if, indeed, an exact relation can be said to exist towards so uncertain a *modulus*.

In the course of these observations, bars of many kinds of metal were carefully measured, and in some, the expansions for small changes of temperature nicely ascertained. Copper of different sorts, cast iron, cast steel, wrought iron, both Swedish and Low Moor, were all employed. It was conceived, in fact, that the problem was solved; and that little remained but to select the bars required for the New Parliamentary Standards, to follow out some of the expansion experiments in greater detail, to recompare, perhaps, if it were required, the definitive yard with the copies of the lost imperial yard, and to prepare properly tested thermometers.

The first thing done after last vacation was to pick out a few yards, which were sharply divided, floated evenly in mercury, and came nearest in length to the imperial yard, according to the presumed value of Bronze 12. Some of these had been compared

with Bronze 12 directly, but others had been compared by the intervention of the bar with split cylinders for divisions. From some cause, which is quite inexplicable at present, bars of the latter description do not by any means agree with their previous values. There was no remedy but to consider the measures of this family as not made, and to compare them anew. A new bar, which floated more evenly than Bronze 12, was nearer the imperial yard in length, and more neatly divided, having been selected for the model, the observations have been recommenced, and four bars have been selected, which are very nearly equal, and which are believed to agree very nearly with the lost yard.

It was suspected that the immense weight of the trough with all its appendages might have some disturbing effect upon the direction of the microscopes, as the trough does not remain in the same position at the respective measurements of the bars. This suspicion seems to be well founded from the observations of the last two months; the bars have changed places in the middle of the series, and it is found that the exterior bar requires a small plus correction to give its true relation to the inner bar. The bars compared with Bronze 12 directly, seem also, so far as they have been examined, to preserve their former values within the limits of observation.

There is, however, one anomaly which has not yet been eluded, and which seems to result from the personal constitution of the observer and a peculiarity in the divisions. It is well known that two observers may habitually differ very sensibly in the bisection of a division, one always carrying the wire a little too far, and the other hanging back. This sort of difference, however, can cause no error without great carelessness. In the measures of the standard yard, if the micrometer heads were placed in the same direction, the *difference* of the readings would give the *length*, and the personality spoken of disappears from the result. If the micrometer heads are placed in opposite directions (as they are in the present operations for restoring the yard), the apparent length, indeed, differs according to the observer; but as this affects both bars equally, the *comparison* is correct. Unfortunately, there is at times a peculiarity belonging to the *division*, and in some cases this is by no means inconsiderable. Bronze 12 has this *peculiar* division, for all the bars which were compared with it by Mr. William Simms, junior, and Mr. Sheepshanks, came out of different lengths by the two observers; and this difference was always the same way, and nearly to the same amount. This *constancy* is a proof that there is some cause for the discrepancy, and the hypothesis which seems most likely is, that Mr. William Simms, junior, whose eye is of singular sharpness and steadiness, sees some defect in the division which escapes the inferior vision of the other observer.* After a large and consistent series of observations with bars 28 and

* One of Mr. William Simms' bisections seems to be at least worth four of Mr. Sheepshanks'; his probable error is not larger than 0·00001 inch. No other observer of the standard yard has at all approached this degree of accuracy.

and 12, in which the difference between the observers was constantly shown, Bar 12 was turned half round, so that the legend was inverted. The *length* of the bar was changed, but the difference between the observers remained as before, nearly one division of the micrometer. Unless this anomaly can be overcome there does not seem to be any mode of arriving at a greater certainty in an absolute measure, or in the subdivisions of a measure by one observer, than a very few observations will warrant. Perhaps $\frac{1}{50000}$ or $\frac{1}{60000}$ inch may be a limit, *i.e.* half of a division of the micrometer.

Another mode of arriving grossly at a higher degree of certainty than one or two observers can ensure, would be by taking the mean of a considerable number of practised observers, and trusting that such a mean would be true of all similar means in future. This was intended, but the arrangements for warming the cellar have failed; and indeed the introduction of dust and smoke would always render the advantage of any ordinary stove problematical. It is, however, very desirable that some means of giving a high and steady temperature should be introduced. First, because at present the place of observation is scarcely safe for a delicate person; and secondly, and more especially, because it is almost impossible to compare satisfactorily measures of *metals* and *forms* which differ from the new bars. In the height of summer, the thermometer just reaches 60°; and it is only then when bars, which do not admit of being plunged in mercury, can be compared with reasonable accuracy. The new standard bars can be compared at *any time of the year*, for a little hot water in the trough will raise the temperature, and the heat of the mercurial bath varies very slowly, and can be measured with great nicety. But there would be little use in comparing Bronze 28 with Kater's scale of *hammered* plate brass, or with Colby's Iron Bars of unknown origin, *at present*, since the expansion of those measures is not known with such certainty that their lengths at 62° can be concluded from their lengths at 45°; nor would the heat, got by pouring hot water into the trough, be sufficiently steady to be measured by unplunged bars and thermometers. If these experiments are to be extended, it would be requisite to adopt a gas-stove, or some similar contrivance, to gain a steady and definite temperature.

By changing the position of the lamps after every five observations of each bar, the evil influence of mal-direction of the light is greatly diminished. At times, the bisection seems to be changed almost a division by shifting the lamps, but this is rare; and generally, both bars are similarly affected. The adoption of gas-light would, however, add considerably to the accuracy and consistency of the separate measures, and in some degree to that of the final results. It would also spare the observer much loss of time in arranging the lamps, and the annoyance of smearing his hands continually with oil and lamp snuff.

The Council can hardly pass over without notice the recent

appointment of their distinguished ex-President, Sir John Herschel, to the post which is so firmly associated with science in the minds of Englishmen by its connexion with the name of Newton. It is to be hoped that the duties of the office, even if rendered more than usually onerous by the necessity of originating and superintending necessary reforms, will not entirely withdraw its occupant, or at most but for a time, from astronomy; and in this persuasion the Council feel assured that the Society will offer its hearty congratulations, as well to Sir John Herschel as to the branch of the public service for which his talents are secured.

The increased attention which has been paid within the last few years to the construction of meteorological instruments, to their examination, and determination of index-errors before use, together with the uniform reduction of the observations, have induced many of our Fellows to take regular meteorologic observations, and series of such observations are now taken at almost all astronomical observatories. Thus a number of good observers have sprung up in different parts of the country, who all work upon one plan. On the 4th of April, 1850, a meeting of gentlemen, all Fellows of this Society, was held at Hartwell House, the residence of Dr. Lee, for the purpose of taking into their consideration the best means of still further advancing meteorology; and the result of their deliberations was the establishment of a new Society, called the "*British Meteorological Society*," for the promotion of the science.

The announcement of this Society has been well received by the public; the number of its members at present exceeds 150, and it has already published forms for recording observations. Some tables for the reduction of observations have been contributed by its members. Its Secretary furnishes a report upon the weather weekly to the *Institute* Journal; and quarterly accounts are furnished to the Registrar-general, to the *Philosophical Magazine*, and to the *Engineers' and Architects' Journal*.

Mr. Bishop's Ecliptical Charts for hours 2 and 3 of right ascension are in the engraver's hands, and will be published immediately. They contain every star, to the 11th magnitude inclusive, within 3° of the ecliptic, north and south. The other charts will follow as rapidly as the weather allows of their completion; and it is hoped that the whole set of charts will be in the hands of astronomers in the course of the ensuing year.

From 1847 to 1850 inclusive, a year has not passed without an addition to our planetary list. During the last twelve months three small planets have been discovered,—a rate of increase in the known members of the solar system which can hardly be expected to continue very long. The methods necessary to be pursued in a search for planets are of a nature to be advantageously practised only after a long experience, whereby the observer

becomes intimately acquainted with the configurations of the telescopic stars, and has established a uniform system of magnitudes for his charts or zones: this is of the utmost importance, and only to be accomplished after a long course of observation. Hence, probably, arises the circumstance that eight of the new planets have fallen to the lot of three persons; for it is reasonable to expect that the success attending the labours of M. Hencke, who commenced the modern series of discoveries, will have induced many astronomers besides Mr. Hind and Dr. de Gasparis to enter the same field.

Of the three planets detected during the past year, the first was found at Naples by Dr. A. de Gasparis, on the 11th of May, and was immediately named *Parthenope* (in conformity with a suggestion of Sir John Herschel's), to commemorate the site of the discovery. It appeared like a star of the 9th magnitude, and was observed till the end of November. The *Berliner Jahrbuch* for 1853 contains an ephemeris of this planet for 1851, which Lieutenant Stratford intends to publish in the forthcoming volume of the *Nautical Almanac*. The period of revolution is found to be 1401 days, placing *Parthenope* between *Hebe* and *Astræa* in the order of mean distance.

The second planet was discovered on the evening of September 13th, by Mr. Hind, at Mr. Bishop's observatory in the Regent's Park, being the third member of the ultra-zodiacal group which has been detected by the system of examination of the heavens and the formation of charts at present pursued there. This planet has received the name *Victoria*, with a star and laurel-branch for its symbol. The period of revolution is about three weeks shorter than that of *Vesta*, or about 1303 days: consequently *Victoria* will follow the second of Mr. Hind's planets (*Flora*) in order of distance from the sun. At the time of discovery she appeared as a full 8th magnitude, but very rapidly grew fainter, and at present is not brighter than stars of the 11th class. Lieutenant Stratford has computed an ephemeris of this planet for the year 1851, which is to appear in the *Nautical Almanac* for 1854.

The *third* planet was found in the course of zone-observations at Naples, by Dr. A. de Gasparis, on the evening of November 2d. It was sensibly fainter than stars of the 9th magnitude, and has now become so small as to require a pretty exact knowledge of its position to distinguish it from the numerous stars of the same brightness. The elements, though of course imperfect at present, appear to place this planet between *Parthenope* and *Astræa*, the periodic time being 1496 days. M. Le Verrier, to whom was delegated the right of naming this planet, has called it *Egeria*. It will be remembered that Dr. de Gasparis found a small planet in April 1849, which received the name *Hygeia*; and in acknowledgment of these discoveries your Council have awarded to Dr. de Gasparis the gold medal of the Society.

The last year has been less prolific in comets than some of its predecessors, but there are yet *two* to be added to the catalogue.

On the 1st of May, Dr. Petersen, the zealous assistant of the late Professor Schumacher at Altona, detected a faint telescopic comet not far from the pole of the ecliptic, in a region of the heavens very well known to him, and close to the position where he had previously made a similar discovery. This comet became distinctly visible to the naked eye shortly before the perihelion passage at the end of the third week in July, and a great number of observations were obtained in Europe and America. The orbit does not sensibly differ from a parabola.

The second comet of 1850 had many discoverers; but priority is due to Mr. G. P. Bond, son of the director of the Cambridge Observatory, Massachusetts, who saw it on the 29th of August, a week previous to the first European observation by M. Brorsen, on September 5th. On the 9th it was found by M. Mauvais at Paris, and Mr. Robertson at Markree, and on the 14th by Dr. Clausen, at Dorpat in Russia. As in the former case, there is no sensible deviation from the parabola in the form of the orbit. The comet was visible till the beginning of November, but was never very conspicuous.

In addition to the comets of Petersen and Bond, we have to record the reappearance, under very gratifying circumstances as regards the prediction, of the periodical comet of Faye. Astronomers are indebted to Lieutenant Stratford for directing attention to this interesting body by the publication of an ephemeris, which enabled Professor Challis to discover and observe the comet with the Northumberland telescope in November last. The elements had been rigorously investigated by M. Le Verrier from the observations of 1843-4; and the perturbations due to planetary attraction having been calculated by the same mathematician, the perihelion passage was fixed for the 2d of April, 1851. The observations taken by Professor Challis confirm, in the most striking manner, M. Le Verrier's prediction, the correction to the mean motion necessary to bring about a perfect accordance between theory and observation being very minute. This circumstance is the more satisfactory, as there was no return of the comet prior to 1843 to guide the computer in his determination of the length of the major axis, as was the case with the celebrated comets of Encke and Biela. Hence the return of Faye's Comet has afforded a most gratifying proof of the progress we have made in the theory and practice connected with this department of astronomy. The facilities afforded in the correction of the elements, by M. Le Verrier's method of introducing a term exhibiting the alteration due to each from any probable correction of the mean diurnal motion, are worthy of remark, and have been exemplified in the present instance. This comet has also been observed by Mr. Bond at Cambridge, U.S.

Papers read before the Society from February 1850 *to February* 1851.

1850.

March 8. Note on Computing the Orbit of a Comet. Mr. Waterston.

Appendix to Note on Computing the Orbit of a Comet. Mr. Waterston.

Description of a small Equatoreal and Dome. Mr. Fletcher.

On the Star *Pollux*. Mr. Fletcher.

On the Transit of the Fourth Satellite of *Jupiter*. Mr. Lassell.

Proper Motions of 875 Stars of Greenwich Catalogue. Rev. R. Main.

April 12. Observations of Minor Planets. Mr. Hartnup.

On the late extraordinary Cold Weather. Dr. Forster.

On η *Argûs*. Mr. Spreckley.

Observations of Western Light. Mr. E. J. Lowe.

On the Comet of Long Period. Mr. Hind.

Addition to Note on 1830 Groombridge. M. O. Struve.

Notice of a Comet seen at Rio Janeiro. Mr. Curley.

On a Machine for calculating Corrections to Transit. Mr. Carrington.

On determining the Longitude by Observation of Moon's Altitude. Mr. Aske.

On the Phenomena attending the Disappearance of *Saturn's* Ring. Rev. R. Dawes.

Observations of Latitude of *Neptune*, and of a remarkable Appearance of *Jupiter*. Mr. Lassell.

Observations of *Hygeia*. M. Rümker.

May 10. Observations of *Mars*. T. Maclear, Esq.

Notes on B.A. Catalogue. Captain Jacob.

Errors in Shortrede's Logarithms. Mr. Galbraith.

Occultations of Stars by the Moon. Mr. Snow.

Observation of *Iris*. Mr. Hartnup.

On the further Reduction of Bessel's Zones. M. Weisse.

Observations of γ *Virginis*. Mr. Hartnup.

On the Comet of Pons 1818. Mr. Pogson.

Observations of Planets. Mr. Graham.

Notice of Errors in the *Histoire Céleste*. The Astronomer Royal.

Observations of Planets. Mr. Hartnup.

Observations of *Hebe*. M. Rümker.

Elements and Ephemeris of *Hygeia*. M. D'Arrest.

On the Reduction of Sidereal Time to Solar. Rev. J. M. Heath.

Comet Circular. Professor Schumacher.
On Adaptation of Calculations for Occultations at Greenwich to another Place. Professor Chevallier.
On the Calculation of slowly Converging Series. Sir J. Lubbock.
Continuation of Paper on Transit Regulator. Mr. Carrington.
On the Orbits of *α Centauri*, &c. Captain Jacob.
On the Weights to be given to the separate Results for Terrestrial Longitudes, determined by Observations of the Moon and Fixed Stars. The Astronomer Royal.
Graphical Mode of computing Excentric Anomaly. Mr. Waterston.
Observations of Petersen's Comet. M. Rümker.

June 14. Observations of Double Stars. Rev. W. R. Dawes.
On a Universal Reference Number for Star Catalogues. Mr. Drach.
On *γ Virginis*. Mr. Fletcher.
On an Instrument for correcting Transit Error. Rev. J. Challis.
Occultation of *Jupiter* by the Moon. Signor Secchi.
On the Star B.A.C. 535. Professor Johnson.
On the Longitude of George Town Observatory, U.S. Mr. Curley.
Elements of Petersen's Comet. Mr. Pogson.
Discovery of *Parthenope*. Signor de Gasparis.
Observations of *Parthenope* and Petersen's Comet. Mr. Hind.
Observations, Elements, &c., of Petersen's Comet. Professor Schumacher.
Observations of Petersen's Comet. Professor Chevallier.
Observations of Petersen's Comet. Mr. Boreham.
Various Observations. M. Rümker.
Various Observations. Mr. Hartnup.
Various Observations. Professor Chevallier.
On a Rectification of the Altitude and Azimuth Instrument. The Astronomer Royal.
Elements of Petersen's Third Comet. Mr. Breen.
Occultation of *Jupiter* by the Moon, May 19, 1850. Captain Shea.

Nov. 8. Note of Modification of a divided Eye-piece. The Astronomer Royal.
Ephemeris of Petersen's Third Comet. Professor Schumacher.
Notice of Right Ascension of certain Stars, &c. Lord Wrottesley.
Observations of Petersen's Third Comet. Mr. Boreham.
Measures of *ε Boötis*. Mr. Fletcher.
Observation of 33239, 33244, *Histoire Céleste*. Professor Smyth.

Observations of *Juno*, *Iris*, and Petersen's Third Comet. Mr. Carrington.
Elements and Ephemeris of Petersen's Third Comet. Professor Schumacher.
Discovery of Second Satellite of *Neptune*. Mr. Lassell.
Observations of *Parthenope*. Mr. Lassell.
On the Comet seen by Mr. Jenkins. Mr. Horner.
Notice respecting Lunar Investigations. Professor Hansen.
Observation of Petersen's Third Comet. Lieut. Maury.
Observation of Petersen's Third Comet. Rev. J. B. Reade.
On the Teeth and Pinions to reduce Sidereal to Solar Time. Mr. Henderson.
Letter to the Royal Astronomical Society. Sir John Ross.
Observations of *Hygeia*, *Neptune*, &c. Mr. Hartnup.
Elements of *Metis*. Mr. Graham.
Observations of Planets and Comets. Mr. Carrington.
Estimated Places of a Comet. Captain Shea.
Discovery of *Victoria*, and Observations. Mr. Hind.
Notice of Discovery of a Comet (Bond's). Mr. Graham.
Elements and Ephemeris of Bond's Comet. Mr. Graham.
Notice of Observations of Bond's Comet by MM. Mauvais and Graham. The Astronomer Royal.
Observations of Petersen's Third Comet. Professor Bond.
Elements and Ephemeris of Brorsen's Fourth Comet (Bond's). M. Rümker.
On the Means of getting Greenwich Time at Southampton. Mr. Drew.
On some remarkable Appearances of Self-luminous Bodies. Rev. W. Read.
Elements of *Victoria*. M. Rümker.
Observations of *Victoria*. Professor Smyth.
Erratum in Argelander's Star Zone, 5°, No. 26. Mr. Boreham.
Observations of *Victoria*. M. Rümker.
Account of a New Variable Star. Mr. Hind.
Elements and Observations of *Victoria*. M. Rümker.
Observations of Bond's Comet. Professor Bond.
Discovery of a Comet, and Elements. Professor Bond.
Dec. 13. Elements of *Victoria*. Messrs. Breen and Villarceau.
Discovery of *Egeria*. Signor de Gasparis.
Observations of *Flora*, *Neptune*, &c. Mr. Hartnup.
Observations of *Egeria* and *Victoria*. Mr. Hartuup.
On Observations of *Neptune* as a Fixed Star. Mr. Hind.
Micrometrical Measures of Double Stars, &c. Mr. Maclear.
Note on 70 *Ophiuchi*. Mr. Fletcher.
On the Nomenclature of Stars in B.A.C. Mr. Woollgar.
On the Influence of Heat on the Dispersive Power of Liquids. Rev. T. P. Dale.

On the Ring of *Saturn*. Rev. W. R. Dawes.
Observations of *Victoria*. Mr. Boreham.
On the Longitude of Stonyhurst. Rev. A. Weld.
On Black Discs for Drawings of Double Stars, &c. Mr. De la Rue.
On a Method of computing the Corrections for clearing the Lunar Distance. Mr. J. Riddle.
Observations of *Victoria* and *Egeria*, and Ephemeris of *Egeria*. M. G. Rümker.
Observations of *Victoria*, *Metis*, &c. Professor Challis.
Supplement to Paper on the Regulation of Clock-work for effecting the uniform Motion of an Equatoreal. The Astronomer Royal.

1851.
Jan. 10. Elements, &c., of *Metis*. Mr. Graham.
Ephemeris of *Egeria*. M. Vogel.
Letters to Captain Smyth on various Subjects. MM. Everett and Gilliss.
Second List of Stars observed in Right Ascension from B.A.C. Lord Wrottesley.
Observations of *Victoria* at Washington, U.S.
Corrected Ephemeris of Faye's Comet. M. Le Verrier.
Speculations respecting Satellites. Mr. Cullimore.
Ephemeris of *Metis*. Mr. Graham.
Mean Place of Hind's Star. M. Rümker.
Elements of *Egeria*. M. G. Rümker.
Observations of *Victoria*, *Metis*, and *Egeria*. Mr. Hartnup.
Suspected Division of Outer Ring of *Saturn*. Mr. Lassell.
Diagrams of *Saturn* with Explanations. Rev. W. R. Dawes.
Note on Name of *Victoria* given to his Third Planet. Mr. Hind.
Letters on *Saturn's* Inner Dark Ring. MM. Lassell and Hind.
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Report from Observatory Cape of Good Hope. Mr. Maclear.
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Description of the Cape Equatoreal. Mr. Maclear.
Remarks, &c., on Southern Stars in B.A.C. Mr. Maclear.
Second Series of Southern Stars in B.A.C. Mr. Maclear.
Observations of Satellite of *Neptune* and of *Jupiter*. Mr. Lassell.
Drawing of Solar Spots. Mr. Prince.

List of Public Institutions and of Persons who have contributed to the Society's Library, &c. since the last Anniversary.

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Royal Society of Edinburgh.
Royal Irish Academy.
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Royal Asiatic Society.
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Imperial Academy of Sciences at Vienna.
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Address delivered by the Astronomer Royal, President of the Society, on presenting the Honorary Medal of the Society to Dr. Annibale de Gasparis.

It is now my duty, Gentlemen, to announce to you that the Council have awarded the Medal of the Society to Signor Annibal de Gasparis, for the discovery of the three planets, *Hygeia*, *Parthenope*, and *Egeria*. The nature of these discoveries scarcely allows of any very elaborate commentary, yet perhaps a few remarks upon the methods by which these and other planets have been found may not be misplaced on the present occasion.

Seventy years since, the only planets known to men of science were the same which were known to Chaldean shepherds thousands of years ago. The "five other wandering orbs" of Milton, whose number Kepler once conceived to be fixed by the immutable laws of necessity, were still the only recognised wanderers in the sky. Although the notion of a fatality in the precise number had doubtless passed away, yet the impression produced on men's minds by the unbroken recognition through many ages of five and only five planets, possessed nearly the same force. The discovery of a new veritable planet seems to have given rise to the same kind of emotions as would be produced now if we found a class of animals possessing a new kind of sense; as a perception of magnetism, of photogenic

radiation, or of polarization. This discovery was made by the elder Herschel; and it was truly the fruit of accident, occurring in the course of sidereal researches, in which the discovery of planets does not appear to have been contemplated. Let me not, however, be understood as disparaging from the claims of Herschel to the fame which he acquired. Another person might have seen the new star; but scarcely another person would have instantly remarked its peculiarity of appearance, would have interrupted his sweep in order to follow it, and would have immediately determined its place so well as to be able in a short time to see that it was a moving body. Acute senses, rapid judgment, and prompt action, were necessary; and they were successful. And the innovation thus made in the subjects of thought for the speculative astronomer appears to me the greatest that had been made since the establishment, among men of science, of the doctrine of the movement of the earth.

The spell was now broken; and the accidental discovery of another planet (*Ceres*) at the beginning of the present century, excited therefore little emotion on the mere ground of the discovery of a new planet. But it was interesting on another ground; that the position of the new planet, in respect of distance from the sun, corresponded well with an empirical law, which was generally founded on the known distances of the other planets, but which required for its completeness the interposition of another planet at the newly-found distance. This interest was increased when, upon examination of stars seen near to *Ceres*, it was discovered that one of these was moveable, and that it was also a planet (*Pallas*), with mean distance from the sun differing very little from that of *Ceres*. The idea was promulgated that these two might be fragments of one great planet, and that possibly other fragments of the same planet might be found; and it was reasonably inferred that if these fragments had been formed by one great explosion, the orbit of every one of the fragments must (except as affected by perturbations) continue to pass through the point of explosion; and, therefore, if we noted in the heavens the point of intersection of the orbits of *Ceres* and *Pallas*, and kept up a constant watch on the neighbourhood of that point, we must infallibly discover all the other fragments. That limited tract of the sky was like a pass in a mountain-chain; however much the travellers might wander over the plain in their approach to it, they must necessarily all traverse that narrow gate; and *there* was the place where a detective police might be stationed with a good chance of arresting suspicious vagrants. And now the process for the discovery of planets assumed a new and a systematic form. A confederation of German astronomers, mainly under the direction of the celebrated Olbers, undertook and maintained for many years a regular watch of the portions of the heavens indicated as the planet-portals. *Juno* and *Vesta* were thus discovered. And so steadily did Olbers keep up his examination, that he was at last able to assert that no other new planet had passed the guarded

space from 1808 to 1816. This assertion must, of course, be understood as limited by the powers of the telescope which he used, and which was much inferior to those employed in more modern researches.

It was, apparently, amid the reflections naturally suggested by the arduous labours of these still somewhat isolated inquiries, that the idea of more completely examining and recording the appearance of the heavens at a definite time grew up. On 1825, Nov. 1, the Berlin Academy issued its celebrated invitation to astronomers, to co-operate in forming maps of the heavens within certain limits of declination. The probability of finding planets by this means was distinctly pointed out in that document. The response to the invitation has been very satisfactory, though even yet not perfectly complete; and it is impossible to overrate the effect which it has had in promoting the discovery of planets. This it has done, not simply by the direct use of these charts for comparison with the heavens, although the first planets of Hencke, Hind, and De Gasparis, as well as another to which I shall shortly allude, were thus discovered; but also by the stimulus which they have given, and the example which they have afforded, for the formation of other more accurate charts (for the most part unpublished), such as those by which the later planets of Hind and De Gasparis, and that of Graham, were found.

In the meantime another planet was found, under circumstances probably the most extraordinary that have ever presented themselves in the history of science. It is not my intention here to enter upon the details of the discovery of *Neptune;* but there is one circumstance connected with it, related to the matter of which I have just spoken, to which I may properly allude. It will at least serve to show how strongly I have felt the disadvantage of not possessing charts like the Berlin maps, and how vividly others have experienced the satisfaction of having them at hand in the time of need. It may be in the recollection of some persons, who have read the contribution to the history of that discovery which I communicated to this Society, that when an approximate place had been indicated for *Neptune* by the theoretical investigations of Adams and Le Verrier, I took the liberty of urging on my friend Professor Challis the probable advantage of examining a certain tract of the heavens, and I at the same time offered some suggestions as to the way of making the examination. In these I distinctly pointed out that the Berlin maps applying to the tract in question were not completed, that only a small corner of one of them was available, and that it was necessary to contemplate the very serious labour of two or three complete examinations. But at Berlin the state of preparations was different. The chart relating to the Neptunian region was just completed by a German astronomer; I am not quite certain whether the proof or one of the earliest printed copies was in the hands of Dr. Galle: a very rapid glance on each part sufficed to show whether any new object had or had not crept into that tract; and a discovery was made with

the assistance of the chart in a few minutes which, without it, might have employed months.

It thus appears that planets have been discovered in three different ways: by accident, by examination of the heavens, as suggested by the investigations of physical astronomy, and by systematic comparison of the visible state of the heavens with the state as recorded in charts. But the number of discoveries made in the different ways is very different: three in the first, one in the second, and eleven in the third. We are justified thus in asserting that there is one method which is peculiarly the proper one for the search for planets; and the employment or non-employment of this method must in some measure affect our estimation of the judgment exhibited by the person who is engaged in the search.

The three planets of Signor de Gasparis were all discovered in this way: the first (*Hygeia*) on 1849, April 12, by comparison with the Berlin maps; the second (*Parthenope*) on 1850, May 11, it is believed in the same manner; the third (*Egeria*) on 1850, November 2, by comparison with the ecliptic charts constructed by Signor de Gasparis from his own observations.

Let me now for a moment invite your attention to the importance of these discoveries. And this, perhaps, can best be illustrated by analogy. When the young naturalist enters first upon extensive examination, not only of the genera and species, but also of the habitats of animals, nothing is more striking to him than to find that life, implying also organisation and order, in some form or other abounds everywhere. The discoveries of astronomy lead us to a similar conclusion. The fields occupied by the specific subjects of discovery are broader, the exploration of their individual characteristics is less accurate; but the same general impression rises on us, that planetary life, so to speak, abounds everywhere. Where, fifty years ago, not a single planet was known to exist, a group of thirteen is now recognised. Of their organisation we can yet say nothing, but of the order with which they follow the laws of motion, inferred from the investigation of the older planets' motions, we have positive assurance. And no one, who remarks how more extended discoveries have followed more improved means of observation, can resist the belief that as we still go on improving our instruments we shall still go on finding more planets, till space, in our solar system at least, may appear, in reference to what was formerly known, comparatively full of these travelling bodies.

I am sure, Gentlemen, that your hearty approval will accompany your Council's award of the Society's Medal for labours judiciously and successfully directed in a course of researches on such an important object. And I trust that our award will be acceptable to Signor de Gasparis, as an evidence that we are not slow in learning and not ungenerous in estimating the efforts of a foreigner in promoting the science which we call peculiarly ours. There is another circumstance which I hope will increase his gratification. The testimony of the Society's respect will be delivered by one of

its officers, who has himself laboured in the same cause and with similar success. And the publication of our adjudication, and of the instrumentality by which we carry it into execution, will serve to convince the world, if conviction were necessary, that neither national nor personal rivalry disturbs the appreciation of labours ably directed to a worthy object.

(*The President, addressing himself to Mr. Hind, Foreign Secretary of the Society, as proxy for Signor de Gasparis, continued as follows*) :—

I request you to deliver this Medal, in the name of the Society, to Signor de Gasparis; to express to him the respect entertained in this country, and by none more than by yourself, for his labour, his judgment, and his success; and to convey to him our wishes for the continuance and increase of his reputation in the science to which he has so ardently devoted himself.

The Meeting then proceeded to the election of the Officers and Council for the ensuing year, when the following Fellows were elected :—

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